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GAS LIGHT JOURNAL

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BRIEFLY TOLD.

ANNUAL MEETING, SOCIETY OF GAS LIGHTING.—While the New England Association gatherings mark the time for the first of the yearly reunions of our many Associations of Gas Engineers, to the Society of Gas Lighting is reserved the privilege of bringing to a close, in annual session, the Association history of the year. Looking back over the record of the twelvemonth in this respect, one cannot fail of convincement that each Association has made marked progress in the year that ends the ninth decade of the Nineteenth Century. They have grown in membership, have advanced in fraternity, have prospered financially, and have broadened in culture. The records of the various assemblies, as printed in our official reports of the several conventions during the year, are our proofs in support of our conclusions. Perhaps the advance made may seem, in fact does seem—if certain editorial remarks in our esteemed, though occasionally bilious, English contemporary, the London *Journal of Gas Lighting*, are to be taken as they were written—not very striking to the fraternity in the country that *did once* rule the world; but nevertheless, if the rate of advance is satisfactory to those most interested therein or affected thereby, why, there's an end of it. He who can satisfactorily acknowledge to himself that he has improved, and that he is also satisfied that he does not yet know it all—such a man there is hope for. And as it is with the individual so is it with an Association. In the understanding, then, that our Associations have *improved*, and so are on the way to perfection, and that in time we may even reach (!) the standard already attained by those who sit in judgment at "Bolt Court, Fleet street, E. C., London, England," we will return to our original theme, after joyfully remarking that our Associations up to this point have remained in unity. Further, that though differences of opinion have arisen at one or another time within them, the minority never saw fit to act as though their's was the wisdom, instead of reconciling themselves to the inflation that the majority was wrong. In America the tail hardly ever wags the dog, and never does it after the dog discovers that which is in the wind.

If the other Associations gave evidence of improvement during the year, it may be taken for granted that the Society of Gas Lighting did not lag in respect of that desirable quickening of pace. Indeed the members had good reason for congratulating themselves over the assemblage that at the appointed place in this city, on the afternoon of the 18th inst., waited for the opening of the business of the Sixteenth Annual Meeting of the Society. Nor did they lack for further cause for self-complacency when the annual reports had been read. The Treasurer showed that his carefulness had been rewarded in that the Society's balance had comfortably increased. From the Secretary's records it was determined that in 1890 ten meetings for business had been successfully carried through, and that two others of the kind when business clears the track for pleasure had been thoroughly enjoyed. Of these, one was the annual pilgrimage to Squantum, R. I., with its delicious clambake accompaniment; the other assumed the shape of a day's outing at Coney Island, where Gilmore and the sad sea waves alternately claimed the attention of the members—until the superior attractions of the Manhattan Beach Hotel dining room drew their allegiance from both.

The Society, however, was again reminded from the Secretary's re-

cords—if such reminder were in any sense necessary than to make its sorrow sharper—that death had also been busy in its ranks. Three good and bright and staunch men had gone over to the majority; but time cannot efface from the records nor wear away from the hearts of their fellows that General Charles Roome, Oliver E. Cushing and Theobald Forstall adorned the one and filled the others. Though dead, they live.

During the year Messrs Henry B. Leach, of Taunton, Mass., Charles F. Prichard, of Lynn, Mass., and Edward G. Cowdery, of Milwaukee, Wis., were admitted to membership.

With the reading of the reports the usual routine business was brought to an end, and the annual election was gone into. This resulted as follows:

President.—J. Russell Thomas.
VicePresident.—Eugene Vanderpoo..
Treasurer.—William Combe.
Secretary.—Fred. S. Benson.
Member of Executive Committee.—F. C. Sherman.
Finance Committee.—Albert M. Smith, Alexander Strecker, C. H. Coggeshall.

The annual dinner was then served, and it was in strict keeping with those that the Society always enjoys. In fact, mention of it and the way in which it is provided bring to mind the idea and belief that other Associations might have no further cause for discussing their banquet feature, did a like practice prevail with them.

The informal discussion that followed the removal of the cloth was most enjoyable, and when the hour for adjournment arrived the members separated in the full knowledge that the last twelvemonth of the Society would more than compare with any of its predecessors in point of technical advancement and enjoyable fraternity.

Arc Lighting, New York City.—It will be remembered that some weeks ago the Gas Commission rejected all the bids that had been submitted by the various electric lighting companies of this city, under the invitation of the authorities to maintain a certain number of high power arcs on the streets. The reason then given was that the bids evidenced the formation of a combination on the part of the Companies, by which competition was virtually strangled, with the concomitant of high prices. New tenders were then advertised for, and these were submitted to and opened by the Commission, on the 23d inst. The bidders were the United States, Brush, East River, Mount Morris, Harlem and North New York Companies, and the figures again show that the Companies do not compete in any sense. The territories have been apportioned by them as before; but as the average new figure—40 cents per lamp per night—will likely not exceed the total appropriation made by the Department, for the number of lamps to be lighted, it may be taken for granted that this time the Commission will bow to the inevitable. The former bids averaged 43 cents per lamp per night. Looking the field over dispassionately, we are inclined to the view that the electric companies have had the better of this argument all the time. They acknowledge that a fair profit cannot be made by them at a figure per lamp lower than those put in; hence, if New York is desirous of obtaining good service at an honest rate of pay, there would seem to be no valid reason why that payment should not be made—if the service is rendered according to contract.

A Business Change.—Our advertising columns for this issue contain an announcement that the firm of Connelly & Co., Limited, has been dissolved, and that the business will hereafter be conducted under the firm name of the "Connelly Iron Sponge and Governor Company." The capitalist most largely interested in the new Company, Mr. S. F. Hayward, has been identified with the old firm of Connelly & Co., so the change is not a complete one. We have no doubt that the Connelly Iron Sponge and Governor Company will amply merit a continuance of the business patronage that was justly awarded its predecessor. In the meantime it gives us real pleasure to remark that the Messrs. Connelly do not intend to give up active connection with the gas industry. Quite the contrary, they will soon put upon the market a gas engine, wherefore we may speedily behold the announcement that the Connellys', Limited, are prepared to carry on an unlimited business in their new specialty.

Obituary Note—Nathaniel Tufts.—In our issue for November 17 we briefly noted the death of Mr. Nathaniel Tufts, who died at his home in Boston, on the afternoon of November 9. His death, which was occasioned by a fall from a window on the second (rear) floor of his residence, was peculiarly distressing from the circumstances that compassed it. Mr. Tufts was renewing a sash cord that had parted in a window frame at the rear of the second floor of his house. The sash was down, and Mr. Tufts was standing on the top rung of an ordinary house stepladder, the latter being steadied by his wife. Mrs. Tufts turned to pick something up, when the ladder toppled and Mr. Tufts was thrown through the open window to the pavement below. When willing hands lifted him up a moment or two later, it was found that he was unconscious, and death followed speedily. Mr. Tufts was born in Malden, Mass., on October 28, 1824, and learned the trade of a tinsmith, having been apprenticed in the shop of his father. At the end of his apprenticeship he went to work on gas meters for a Mr. Darricott, who will be remembered by some as the first Agent for the Boston Gas Light Company. Shortly afterwards the firm name waa changed to that of the Boston Meter Company, Mr. Tufts being chosen Superintendent thereof, and acted as such until 1857-8. In 1860 Mr. Tufts started in business himself under the firm name of Tufts, Cheever & Co. In 1862 Mr. Cheever withdrew, and the firm became that of Tufts Brothers, remaining so until 1878, when the present house of Nathaniel Tufts was founded. Personally Mr. Tufts was much liked, and despite his 66 years bore himself with spryness and activity.

We might here say that the business of the firm will be continued in the same name and manner as before.

Resolutions Respecting the Late R. McC. Graham.—The following resolutions explain themselves:

Office of the Equitable Gas Light Company, of New York, 340 Third Avenue, New York, Dec. 18, 1890.—At a meeting of the Board of Directors of the Equitable Gas Light Company, of New York, held this day, the following resolutions were adopted in memory of the late Col. R. McC. Graham:

"*Whereas*, Since the last meeting of this Board, Divine Providence has seen fit to take from among us our esteemed President, Colonel Robert McCoskry Graham; therefore,

"*Resolved*, That while we bow in humble submission to Nature's decree, we do so in deepest sorrow, deploring the loss of a valued friend, a wise counselor, and a most faithful and efficient officer. We are mindful that the full measure of success which has been attained by this Company is largely due to his untiring and well-directed energies in its behalf, from the beginning of its business until a fatal illness forced him to rest from his labors. His death leaves a pang in our hearts and a void in the community in which he lived.

"*Resolved*, That, as a slight testimonial to the memory of the deceased, the foregoing be spread upon the records of this Board, and a copy thereof sent to his family. J. P. Miller, Secretary."

"Riverdale Park Company, 160 Broadway, New York city, New York, December 18, 1890. At a special meeting of the Board of Directors of the Riverdale Park Company, held this day, the following preamble and resolutions were unanimously adopted:

"*Whereas*, It has pleased the All-Wise Providence to remove from our midst our late Vice-President, Mr. Robert McCoskry Graham; and

"*Whereas*, During our association with him we have ever found him to be an upright man, a capable and efficient officer and a true and faithful friend; therefore

"*Resolved*, That by his death we have sustained the great loss of an officer, counselor and associate, and we deeply sympathize with his bereaved family in their loss of an exemplary husband and kind father.

"*Resolved*, That these resolutions be suitably engrossed upon the minute book of the Company, and that a copy, duly signed by the President and Secretary, be forwarded to the family of the deceased.

"John Fox, President. W. H. Connell, Sec."

The Market for Gas Securities.

To-day (Friday) on the Exchange is virtually a dead-letter day, and the severe storm prevailing is as greatly responsible for the absence of business as is the fact that we are just on this side of one of the most generally observed holidays of the year. At noon no sales had been made in Consolidated, hence the closing figures of Wednesday must be accepted as the ruling value of that security—92 bid, 93 asked. In this connection it might be noted that the value of the shares at this time in 1889 was 92¼ bid, offered at 93, all of which goes to show that, despite the rough money times, of August-September and November-December, Consolidated managed to come out unscathed in the twelvemonth. When confidence shall have been restored, we make no doubt that Consolidated will easily climb to the par mark, there to stay.

Chicago gas was weaker to-day, opening at 34¼ and declining sharply to 33¾. Laclede gas remained strong and active during the week, selling at one time at 17½. Brooklyn shares are inclined to better prices, seemingly, although it would appear that they were well up to intrinsic value at ruling rates.

[Concluded from page 877.]

The Artificial Light of the Future.

[A paper read by Mr. Edward L. Nichols, before the N. Y. Electric Club.]

We have seen that, weight for weight, magnesium affords more than 30 times the light obtained from gas, with the development of much less heat. The quality of the light is such that merely from the standpoint of illuminating power, to say nothing of the additional æsthetic value of a light which approaches sunlight in whiteness, each unit of it must be regarded as the equivalent of rather more than 1.25 units of gas light.

The character of the light corresponds to a temperature much above that of the electric arc, but the flame does not seem to be very hot. I have not as yet succeeded in obtaining a satisfactory measurement of the flame temperature, but a preliminary test made at my request gave approximately 1,400° C. This value, which is presented subject to correction, enables us to classify the magnesium flame, at least placing it among those the temperature of which is far below the melting point of platinum. Its temperature, probably, does not differ widely from that of the luminous gas flame.[1]

The large candle power of the magnesium flame is due to its peculiar structure. A gas flame consists of a column of heated gases, the particles of which are rising rapidly from the jet of the burner. These carry off with them, by convection, 80 per cent. or more of the heat of combustion. The flame owes its luminosity entirely to the fact that near the base of the column a few particles of carbon, as yet unoxidized, are heated to incandescence. The total radiating surface of these particles is very insignificant compared with the apparent superficial area of the flame; it is, indeed, not very different in extent from the radiating surface of the filament of an ordinary incandescent lamp of the same candle power. The constitution of the magnesium flame is very different. The product of combustion is the oxide of magnesium, a white, amorphous solid of considerable density; it is, indeed, fully twice as heavy as the metal itself. The oxide remains, for the most part, in the place where it was first formed. It becomes intensely incandescent, and, having large radiating surface, it affords a large amount of light. Under such conditions convection plays a minor part, and that which is the chief source of loss in the production of light by direct combustion of gaseous fuels is avoided. The gross efficiency is, therefore, very large.

I am not in position to state positively that the glow of magnesium oxide is due to luminescent vibrations, but I am of the opinion that such will be found to be the case.

You are all acquainted with the beautiful greenish-yellow light which the oxide of zinc emits under the flame of the blowpipe. It is entirely different from the light of the incandescent charcoal on which it lies, although the two cannot differ widely in temperature. The zinc oxide is luminescent; the carbon is simply incandescent, in the usual sense of

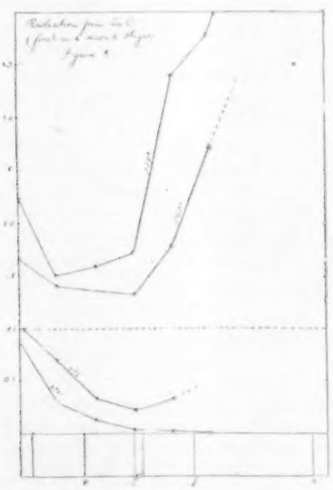


Fig. 8.

the word. This is a case which lends itself readily to study, since the temperature at which the abnormal glow appears is a comparatively moderate one. Last summer I took the matter up, with the efficient cooperation of Mr. B. W. Snow, instructor in physics in Cornell University. We made a systematic comparison of the radiation from zinc oxide and from platinum, at temperatures between the red heat and 1,000° C., measuring temperatures and studying spectra by methods which I cannot dwell upon here. Since the results which we obtained are of a character to illustrate the points which seem to me most significant in this question of the radiation of the metallic oxides, I will indicate them graphically.

Fig. 9.

Zinc oxide is a rather brilliant white pigment. Its radiating power, therefore, according to the theory of exchanges, should be very small. At temperatures below 700° C. we found it to be very much lower than that from platinum throughout the spectrum, and the light from the oxide to be of a duller red. Fig. 8 shows the results of the comparison. In this and the subsequent curves platinum is taken as the standard. The curves show how the oxide of zinc compares with platinum in strength of radiation. The law according to which the visible radiation of platinum rises from zero at the extreme red heat, as the temperature rises, varies with the wave length. It had to be specially determined for the purposes of our investigation in each region of the spectrum to which our measurements were extended.

At about 700° a sudden change occurs in the character of the light from the oxide. It becomes brighter than the platinum of the same temperature, the increase showing itself principally at the ends of the spectrum. In Fig. 8 (707° and 739°) we have curves which represent this second phase. The emanations are selective to a marked degree, the yellow being relatively very weak. Measurements of fresh films of the oxide at still higher temperatures revealed the further development of the abnormal radiation of this substance. Fig. 9, which gives curves for 878° and 1,034°, shows the transition into a third, and, apparently, a final stage. The red end of the spectrum loses its prominence, and the curve seems to be developing into a straight line, the trend of which is such as to indicate that zinc oxide, as we pass from the longer to the shorter wave lengths of its spectrum, increases in superiority over platinum at the same temperature.

It soon became evident, from the character of our results, that the radiation at temperatures above about 800° were of a very evanescent sort, falling off in intensity and changing in quality from the first instant in which the oxide is heated. To follow these rapid changes proved a trying task. By taking a great many fresh films of the oxide and watching the time changes of one portion of the spectrum after another, however, we were able to obtain data from which the curves in Fig. 10 were drawn. These show the intensity of radiation and its character, relative again to that of platinum, after the oxide had been maintained 1,013° for a period of 30 seconds, of 60 seconds, of 300 seconds, and of 600 seconds. At the end of the ten minutes the changes, although not entirely completed, were very slow.

The evidence of the existence of luminescence afforded by these measurements seems to be nearly conclusive. Extension of the investigation to other of the metallic oxides, and to wider ranges of temperature, would doubtless lead to results more striking.

The application of all this to the problem of the light of the future is as follows: The fundamental question is that of efficiency. High efficiency at low temperature means selected radiation, which appears to be characteristic of luminescence and not of ordinary incandescence. The study of the radiation of the metallic oxides above the red heat reveals the existence of properties which lead us to regard them as being lumin-

1. Rossetti (Beiblaetter zu den Annalen der Physik 2, p. 333), gives as the temperature of the gas flame, 1,340 degrees; of the positive carbon of the arc, at the hottest point, 3,500 degrees; of the negative carbon, 2,450 degrees.

escent "by heat." It is from such bodies that radiation of high efficiency is to be looked for. We have in magnesium oxide a member of this particular class, and we have seen that when it is heated in the process of formation it gives us a light the efficiency of which is unapproached by that of other artificial illuminants.

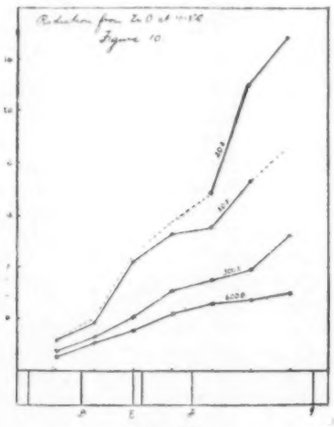


Fig. 10.

The problem is easily stated. (1) We need a body which is rendered vividly luminescent by heat. The metallic oxides would seem to offer us many such. (2) The material is to be brought to the temperature at which its luminescence is most marked. Does it not seem probable that the best method, as in the case of carbon, will not be that of direct combustion, but of heating through the agency of the electric current? (3) The material must be restored from time to time. Whether rejuvenation is to be secured through electrical, chemical, actinic, or mechanical means remains to be determined.

Luminescence "by heat" offers, however, only a partial solution of the problem of the highest efficiency. However great the efficiency of the luminescent itself, it is accompanied by incandesence of the ordinary kind. The ultimate solution is to be sought for along other lines. Incandescence is too expensive a means of exciting luminescence. There are many other ways in which it may be generated, friction, chemical action, the impact of light waves, electrical excitation, certain vital processes, are known to result in the production of light. The physics of these phenomena, are, for the most part, undeveloped. I know of but two attempts to determine the efficiency of this "light without heat," as it has sometimes been called. The intensity is, as a rule, very small, and the heat has doubtless been regarded as quite below the range of even our most sensitive apparatus. One of these two cases is of especial interest to the electrician. It is that of the spark discharge in vacuo. Prof. S. P. Langley and F. W. Very, in a recent remarkable paper entitled "The Cheapest Form of Light," speak of the heat generated in the Geissler tube as so minute as to seem to defy direct investigation. It has, however, been successfully measured by Dr. Staab, of the University of Zurich, by means of one of the most delicate instruments for the measurement of heat—the Bunsen ice calorimeter.[1]

In Staab's experiments the vacuum tube was smoked with lamplack and inserted in the ice calorimeter. The ice melted in a given time afforded a measure of the total heat generated by the electric discharge through the tube. A repetition of the determination with the unsmoked tube, under which conditions the light giving rays would escape, gave the energy of the non-luminous radiation. The efficiency was found to be 3.268 per cent. The extremely small candle power of the light derived from the electric discharge in vacuo may seem to preclude all questions of its utilization in practical illumination. The result is one, however, which should not be lost sight of. It suggests a field of investigation which may prove unexpectedly fruitful.

The Geissler tube effect was not the source to which Langley and Very applied the term "the cheapest form of light." The subject of their research was the light of a Cuban firefly. Their work cannot fail to excite the highest admiration of everyone who is able to appreciate the difficulties of such an investigation. The exploration of the heat spectrum of so insignificant a source of light is a task which very few physicists would, I think, have considered practicable, but it has been carried through by these investigators to complete success.

When we study the curve of distribution of energy in the spectrum of the firefly thus obtained, and compare it with the corresponding curves of gas light, the arc light and sunlight, we find the expression, the "cheapest form of light," which is applied to the light of the firefly by Langley and Very, to be fully justified. All the energy of its spectrum is massed within the narrow limits of the visible spectrum, and what is more, by far the greatest part of it is in the form of rays, which are especially important for the purposes of radiation, the particular rays which give us yellow and green light. The non-luminous radiation which accompanies the light of the firefly seems to be so insignificant that it was with difficulty that it could be estimated, even with the almost inconceivably delicate apparatus used by Langley and Very. They give the efficiency as about 400 times as great as that of a gas flame. It cannot fall appreciably below 100 per cent.

In what I have said this evening I fear that I have fallen far short of what might have been expected of a lecturer on the artificial light of the future. I have endeavored to show that the efficiency of our present methods is too low to meet the demands of the future for economical illumination, and that whether we ever succeed in approaching the perfect economy of nature's light making processes, as exemplified in the firefly, or not, there are many sources of light which promise high efficiency. If I have succeeded in indicating, even vaguely, some of the conditions of the problem of the utilization of these, and in pointing out some of the lines of investigation which are to be followed in the development of new methods of lighting, my mission has been fulfilled.

1. G. Staab: Inaugural Dissertation, Zurich, 1890. (See the *Beiblatter zu den Annalen der Physik*, 14; p. 538.)

Conditions of Safety in the Use of Geysers.

[A paper read by Mr. George Ewart, before the Balloon Society of Great Britain, St. James Hall, London, England.]

The number of Geysers now in use in this country is probably no less than 50,000. They are used in dairies, for bottle-washing, and for many other purposes, but nine-tenths, it may be safely reckoned, are in bathrooms. Nine-tenths, if not a larger proportion, of these bathrooms are very small rooms, about 8 ft. by 6 ft. by 10 ft., having a cubical contents of less than 500 ft. Very few of them have a fireplace, and only a small proportion of them are fitted with any other ventilator. It is unnecessary to add here that any instrument consuming a large quantity of gas in a short time is dangerous in such rooms. When all the circumstances are fairly considered, it must be admitted that it is not surprising that we have heard of accidents; it is rather wonderful that we have not heard of more.

At the outset I am free to confess, on the part of the firm I represent, that as manufacturers we did not at first properly understand the danger, and did not take proper steps to guard against it. We actually went so far as to tell our customers, what we fear some makers still say, that the geysers might safely be used without a special escape pipe; and did what we are sorry to find is still being done—we actually sold them without any special socket to which an escape pipe could be readily attached. Our only excuse is a poor one, viz., ignorance of the danger—for it was undoubtedly a culpable ignorance. We ought better to have known the scientific conditions before venturing on such a trade. Those who are spreading the elements of scientific knowledge amongst practical men are saving more lives than they can tell. It is no exaggeration to say that if our foremen and workmen had known 10 years ago as much as they know to-day of the nature of gases, of combustion, and of the conditions of vitality, they would have prevented such mistakes from being made however much those more responsible might have failed. Even after some deaths had occured we were not fully alive to the necessary conditions of safety, and for a time tried to avert further disaster by issuing warnings against using the bath while gas was on.

We attached labels to the effect that the door must be left open whenever the geyser was in use; destroyed all circulars which stated that the geysers might be fixed without pipe; arranged our cups with ventilating sockets, etc. Unfortunately a great many geysers of different makes were already fixed all over the country, and it was not possible to reach all their owners by advertisements or circulars, and, although we did much to make the danger known, the sad event has proved that it was too little. Even now our difficulty still remains, viz., to obtain the attention of many who have had geysers in use for years. I very gladly accepted the kind invitation of this Society, in the hope that some additional publicity might be given to the subject. As you will see, the question is really very much one of publicity. If we can by any means make the facts sufficiently known, we may hope that no more accidents will occur, for it is not difficult to devise measures of safety for the future. The difficulty is to counteract the mischief of past errors of carelessness.

It will, perhaps, be worth while before going further to attempt to

answer the question which some may be asking, viz., "What is a geyser?" The term has come to be applied pretty generally to any instrument used for heating water on one particular principle. So far as I am aware, the principle was first practically applied by the late Mr. Maughan. Mr. Maughan's method was that of passing the water over a number of spiral wires which, being suspended in the gas fumes, the water, divided into small particles, rapidly absorbed the heat. The principle was that of absorbing the heat by flowing water. The old gas-circulating boilers heated the water as the range boilers now do, viz., by flow and return. After them gas baths were made (and are still sold) with gas under the bottom, heating the water upon the old kettle or saucepan principle by convection. Mr. Maughan's plan was much swifter and more economical, as the flowing water came always cold to the hot wires or hot fumes, thus absorbing the utmost possible heat. The same principle is applied in many different methods, and the term "geyser" came to be applied by the public to them all. Whenever the term is used in the present paper this particular kind of apparatus is intended. Very much the same danger exists in the use of the old circulating gas boiler or the saucepan bath; but these are so fast being superseded by geysers of some form that they are of much less importance.

What, then, is the actual danger in the use of a geyser? It consists, not in the geyser itself, but in the small size of the bathroom. It was this point which we overlooked at first, and which is not even yet properly appreciated. In the workshop or salesroom the geyser worked with perfect safety. It could be even left to pour out hot water all day long. Several geysers could be in use at the same time, and no harm done. We tested for the quantity of water that could be heated within a specified time, for the quantity of gas consumed; but, alas! not for the size of the room in which the process might be carried on with safety. Now we consider this the most important test of all. In the bathroom we have fitted up for the purpose of experiment we have fixed a geyser of large size at the end of an ordinary 5 ft. 6 in. bath. The room has no ventilation except that afforded by the vent pipe and the opening through which the pipe passes. The pipe is so arranged as to be easily disconnected with the geyser, and then the danger of attempting to do without it is readily seen. In a very few minutes the gas light is seen to increase in size and diminish in brightness, until by the time 9 in. deep of water at 100° F. has flowed into the bath, the flame has extended from 3 in. to 9 in., and has become so thin and blue as to give no light. The experiment is very interesting, and safe enough as long as the gas flame remains alight. But very soon after this stage is reached, the flame goes out, when, of course, the danger is rapidly increased. The flame burning inside the geyser keeps in longer because it is lower in situation than the light, and the draught being stronger, what small supply of oxygen finds entrance under the door or through the floor is first absorbed here; but, of course, the flame loses brightness and increases in volume, and would soon go out if the experiments were continued.

When the gas light has gone out, however, the observer cannot safely remain in the room. Even with this experience he will probably have a headache for an hour or two. For those who have even a very little knowledge of the composition of atmospheric air and the phenomena of respiration, it would be a waste of time to explain what has happened during this experiment; but as the object of this paper is to attract the attention of those who either do not know or do not think of what takes place when they warm their bath by a geyser, you will not think the time wasted by a few words of explanation. When the match is applied to the burner the gas escaping through the jets, being heated by the flames of the match, is ignited. Instead of escaping in the state in which it existed in the pipes, and becoming a mixture with the air of the bathroom (in which form we should have had warning by the strong smell), the gas becomes decomposed by ignition, and the carbon and hydrogen of which it consisted, form parts of fresh compounds. The carbon unites with so much of the oxygen as it requires, viz., 2 parts of oxygen with one part of carbon, and forms carbonic acid gas (CO_2), while the hydrogen unites with other parts of oxygen in the reverse proportion, viz., 2 parts of hydrogen to one of oxygen, and forms what we manufacturers call "water of condensation." With the latter product we have sometimes a great deal of trouble, and it occasionally causes considerable inconvenience to our clients. But as it is never dangerous, however inconvenient, we have not to do with it to-night. It is the former product, viz., "carbonic acid gas," which is our first, and on the whole perhaps, our most formidable foe.

The *British Medical Journal*, commenting on the late accident, states, that 30 ft. of gas produces on combustion 60 ft. of carbonic acid, that is to say, 12 per cent. of the 500 ft. we take as the full ordinary contents of a bathroom. According to the same authority, a much less proportion, viz., 5 to 10 per cent. is usually considered enough to produce fatal results. It seems very clear that when no ventilation exists the carbonic acid alone would be quite sufficient to kill. But while some of the carbon set free by ignition has been uniting with part of the oxygen to form carbonic acid, and the hydrogen with its share of oxygen to form water, another and more deadly though less bulky compound has also been forming by the union of some of the carbon with some of the oxygen in a different proportion, viz., equal parts. The product thus formed is called carbon monoxide (CO). This gas kills not by smothering as carbonic acid does (that is to say by the exhaustion of needful oxygen), but by poisoning, that is to say, by attacking the blood directly and altering the character of the red corpuscles. We see therefore, in the *post-mortem* reports that the poor victims are both asphyxiated and poisoned. I remember that in conversation with an eminent doctor I was once told that one part in a thousand of carbon monoxide was enough to endanger life, and if so it is really wonderful that more accidents have not occurred. I believe also that the vapor arising from the hot water assists the conveyance of this deadly product, so that a person in the bath readily inhales it.

It is needless to dwell longer upon the elements of danger in the use of geysers, but I will just say here that we cannot be surprised if some writers in view of the facts, and under the impression produced by the sad accidents that have occurred, advise the giving up of the whole system. We should certainly endorse such an opinion, and at once abandon the manufacture if we did not think there was a more excellent way. But even though we and all the rest of the present makers were to give up the manufacture this would not do any good, for the demand for some ready means of obtaining hot water for baths and other purposes by such a convenient agent as gas will surely produce a supply. In the public interest, therefore, as well as in their own, the proper thing for makers to do seems to be to devise and carry out a safe method for using instruments which the public will certainly have, even though a considerable element of danger should attach. After all, even though the number of accidents, according to the medical journal, has reached two figures, this does not appear to the ordinary consumer such a formidable proportion as to deter him from using a geyser (as he says to himself) with proper care. It is but one accident for 2,000 or 3,000 geysers, and these he thinks would not have happened had the owners exercised proper care. We are far from saying so, but this is the sort of thing we hear continually from our customers. We conclude, therefore, that though it might be an easier way to dispose of the difficulty if it were possible to prevent any use of geysers for the future, as it is evidently impossible to do this, the suggestion of it is of no use, and, therefore, the proper thing to do is to make the safe method of use as widely known as possible. First it is necessary to speak of proposals which we consider inadequate. These actually increase the danger when they cause a false sense of security. We regard as really injurious (under the circumstances) such warnings as we ourselves once issued, and as are largely repeated in the Press, to the effect that door or window should be left open while the geyser is in use. It is true that if this were always done no accident would happen. The danger lies in the self-evident fact that no matter what the warning is, it will not be always done. However, the warnings are given, whether by circulars, or in directions for use, or even if stamped upon the body of the geyser, they will certainly be neglected. One instance that came under our own immediate notice will clearly show this.

The victim was a little girl of 10 years old, the only child of a caretaker who had been left in charge of a large house at the West-end. Though this occurred before we were fully aware of the danger, the caretaker had been sufficiently warned. The lady of the house, who had used the geyser for several years, was well aware of the risk, for the bathroom being very small and no ventilation in it, she had felt the bad effects when the door was shut, and had warned the caretaker and his wife before leaving London. Besides this, the caretaker had himself experienced the bad effects, having had a rather narrow escape of smothering. He had, therefore, given the strictest instructions to the child not to go into the bathroom. One day, however, the child was missed, and when found was lying dead in the bath, with the geyser still on, if I remember rightly. What use could verbal, or printed, or even stamped warning have been in such circumstances? On the other hand, they become positively the worst element of danger in leading people to trust to them instead of to a real protection.

Another mistake that requires to be guarded against is that of supposing the danger to be avoided by the use of any particular form of manufacture, or any particular burner. We were at first under the impression that the white flame, such as used for illuminating, was much safer than the blue flame from a Bunsen burner, We still think that, in many respects, the white flame is better, but there is no such difference as prac-

tically to affect the question—one maker may succeed in obtaining more perfect combustion than another, but there is no immediate prospect of any maker being able to produce combustion without the production of carbonic acid. Again, some geysers, being of smaller size or less perfect design, may stretch the process of heating the bath over a longer period and so exhaust the oxygen less rapidly ; but we have seen that much less than the worst is bad enough to be dangerous. Still another dangerous notion is that of providing the bathroom with a ventilator. Good in itself as a warning to open the window is, it becomes an element of positive danger when trusted to. Even if made so as to remain permanently open without any valve that can be closed at the will of the inmate, a ventilator may always be put out of action by placing a towel over the opening, and this would be done without reflection by any careless bather who felt the draught.

As the result of many experiments we have come to the conclusion that there is one and only one way of making the use of geysers in bathrooms safe. I say bathrooms, for, as previously stated, the real danger is not in the geyser itself, but in the small size of the room in which it is fitted. One writer has expressed the hope that the repeated accidents will have the effect of inducing the people of England to do away with their small stuffy bathrooms and fit up their baths in apartments of proper size. We are not very hopeful that much will be done in this line for at least several years to come, and meanwhile we are selling geysers rapidly, and we are only one firm amongst many. Neglecting this as too much in the future, besides being insufficient, even if possible to be at once realized, we are shut up to this conclusion, that the products of combustion must be conveyed outside the bathroom by self-acting apparatus. This may be done partially by fixing a good hood over the top of the geyser, in which the products may collect, and if the hood is of greater diameter than the geyser, and is connected with the outer air by a pipe not less than 6 in. in diameter, the danger would be greatly diminished. There remains, however, a possibility of mischief being done by stopping up the pipe to prevent draught. Should there be any trouble from down-blow it would still be possible to use the geyser, even after stopping up the pipe, unless the hood were made to completely surround the top of the geyser. A much easier as well as safer plan is to gather the whole of the products into a copper cap, which forms a part of the geyser itself, and has a fixed socket of sufficient diameter.

A pipe of the same or larger size connected with this socket conveys the whole of the products outside the room. We call this the "vent" pipe. I have already described what takes place in our experimental bathroom when the vent pipe is detached. Within 15 or 20 minutes after setting the geyser at work the gas light goes out for want of oxygen, and it becomes impossible to light a match in the room. On the other hand, when the vent pipe is refixed the geyser may be kept alight for any length of time without perceptibly injuring the air. Of course, the room becomes warm, but the color of the gas flame is not sensibly altered nor its size increased. A match can be easily lit in any part of the room, even up to the ceiling, and remains burning brightly. We recently asked Mr. Chapple, who read a paper on this subject a few months ago, and who has such sad cause for interest in this subject, to see this experiment tried. Mr. Chapple was good enough to call, and with Mrs. Chapple and myself, entered the small bathroom and stayed while a hot bath was prepared.

When the close fitting doors were shut there was no ventilation besides the vent pipe and the small opening in the partition through which it passed. We lighted the gas jet and kept it alight in front of us, and sat quietly observing for about half an hour with a large geyser in full work. Beyond the increased temperature we felt no inconvenience, and I do not remember that either of us complained of headache. May I say here that if any member of this society or anyone interested in this subject would care to personally try the experiment, the room is at their service at any time, and a very few minutes is enough. We feel justified, therefore, in asserting that if every geyser were fitted with a vent pipe there would be no more fatal accidents. But that is not all. Our experience leads us to think that for every instance of fatal injury there are hundreds of cases of more or less injury to health, and we believe that the vent pipe not only makes the bathroom safe but also healthy. The draught has to be so strong to support the combustion of the large number of jets, that the air of the bathroom is entirely changed during the process of bath heating, and the vent pipe becomes a complete ventilator without causing such an influx of cold air as would incline a bather to shut up another ventilator.

It seems natural to inquire why, if this be so, the vent pipe is not always fixed. The chief reason is that, up to the present time, people are not sufficiently alarmed. In thousands of houses geysers have been in use for years, and, through always taking care to open door or window while the bath is filling, no fatal accident has occurred all that time (though we think there are few cases when, if no vent pipe is fixed, there has not been some inconvenience felt.) It is hard to make people believe that an apparatus can really be so dangerous when they have used it safely for a long time. Then, secondly, it is not generally known that it is unnecessary to carry the pipe outside the house, and people do not like having to make a hole, even though small, through an outside wall. Then, thirdly, although the cost is in itself small, it does increase the first charge for fixing, and this charge is objected to far more than the price of the geyser itself. And, fourthly, there is some risk of more or less inconvenience and trouble with the vent pipe afterwards. It would be useless, even if it were not unfair, to attempt to hide this last difficulty.

When the pipe is carried outside the house there is often a risk that in windy weather there may be a down-blow. The danger from this source is so little as not to be worth taking into account, but the inconvenience may be considerable. When the down-blow is very strong it sometimes makes the flame smoke and even causes it to flare out through the perforation, making the outside of the geyser black and dirty. The inconvenience thus caused is itself the protection against dangerous consequences, as it is impossible to continue using the geyser under such conditions, and the pipe must either be properly shielded or the apparatus put out of action. On the other hand, even when discharged into an open space within the house, inconvenience is sometimes caused by the puff of steam which is apt to escape through the vent pipe when very hot water is drawn from the geyser. We have methods which it would take too long to describe here for dealing with both these difficulties whenever they are found to cause serious inconvenience, but inasmuch as they affect the convenience and not the safety of geysers they do not properly belong to our subject. It only remains for me to mention the steps we are already taking to insure the adoption of the means of safety I have indicated, and to submit to this society a proposition in the public interest. It will, perhaps, be within your recollection that Mr. Chapple, at the close of his lecture, submitted "that the time had arrived when the legislature should take the matter up, and compel the enforcement of such precautions as he had suggested being stamped on these appliances by the makers, and that the omission should constitute a penal offense."

After the lecture a resolution was carried : "That this meeting is of opinion, in view of the many fatal accidents that have arisen by gas and geyser baths, due to the want of a more intimate knowledge of their nature, that the time has now come when the possibility of further fatalities should be avoided by the makers of such apparatus being compelled, under pain of prosecution, to stamp into the metal work of the apparatus, in a conspicuous place, such instructions for their use as have been found necessary, and which are hereto annexed ; and this resolution is humbly submitted to Her Majesty's Secretary of State for the Home Department, as a presentment to him in that behalf. 'Directions for use—Caution : The bath must be filled while the room is being ventilated, and before closing the door. When filled, turn off the gas and water. The bath must on no account be entered until this is done.'" We objected to this suggestion for two reasons. The first I have already indicated. It would have positively increased the danger by causing people to trust to a warning that might be easily neglected by any thoughtless or ignorant person. The second was that words like these stamped into the body of the geyser would become filled up in time and fail to attract attention. Although, therefore, we could not adopt the suggestion exactly as it stood, we made use of the hint, and after mature consideration ordered from Messrs. Willing a supply of enamelled labels (a specimen of which I have), on which is stated very plainly that the geyser must not be fixed without a vent pipe.

In our last order we have, at Mr. Chapple's suggestion, added a further line to the effect that the bath must not be entered while the geyser is alight, but our dependence is upon the warning as to vent pipe. The label is so fixed to the geyser that it could not be removed without disfiguring it, and it is right over the spout, so that it must be seen every time the bath is used. It is difficult to think that any purchaser will be so reckless and foolish as to allow his plumber to neglect a precaution so plainly insisted on, or that any fitter will be bold enough to fix a geyser without a pipe while this warning is staring him in the face. Still, we are obliged to admit that the public is a very careless and foolish person, and that plumbers and gasfitters are frequently obstinate and conceited, as well as sometimes deplorably ignorant. We, therefore, agree with that part of your resolution of May last which requires legislative enactment, and only make this amendment that it should be made a penal offense for any maker to sell an instrument capable of consuming more than a certain quantity of gas per minute without the enamelled warn-

ing as to vent pipe, and also for any fitter to fix any such apparatus in any room containing less than a certain number of cubic feet of air. The machine must also be so constructed as to admit of the vent pipe being easily attached to a socket specially arranged for the purpose.

The Supply of Steam to Regenator Furnaces and the Utilization of Waste Heat for Raising the Same.

By Mr. W. R. Chester.

[A paper read before the Manchester District Association of Gas Engineers.]

The use of water in the ashpits of retort settings is almost universal, and has no doubt been customary from the earliest date of gas making. The rapid dertruction of the fire bars by the direct heat of the combustion of the fuel above, and by the combustion of the cinders below, would very early call for a remedy; and the ashpit, in its present form, and almost without a modification, is no doubt the offspring of this necessity. By placing under the furnace a receptacle filled with water, the hot cinders are quenched as they fall from the fire, and by the heat from these, from the fire above, and from radiation from the surrounding brickwork, this water is kept in a condition of continuous vaporization. The vapor, being cool in comparison with the fire, has a direct cooling effect on the bars; but its usefulness as a cooling agency is due in a far greater degree to its action as a diluent of the air—thus rendering combustion in the lower portion of the fire less rapid and fierce. It is also due to the great absorption of heat from the fire which takes place in the chemical decomposition of the vapor or steam into its elementary gases, oxygen and hydrogen. Owing to this cooling action of the aqueous vapor or steam, the life of the furnace bars is very materially prolonged, and the cost of renewals is kept within such reasonable limits as the manufacture of gas will bear. But while the use of water in the ashpit has its undoubted advantages in prolonging the life of the bars, and to some extent in preventing the formation of hard clinker, it adds neither quantity nor intensity of heat to the setting, but abstracts something from it. The economy effected in the greater durability of the bar is gained at the expense of the fuel account.

The case is, however, different in gaseous-fired furnaces. The steam generally used is not merely that due to the arbitrary vaporization of the water in the ashpit, but is produced from some other source, and conveyed to the furnace by pipes, whereby the admission can be carefully controlled and adjusted to the proper requirements of the fire. The supply of air for primary combustion is also under control—at least in those settings which are built with inside producers: and no one who has had the privilege of working the two systems of inside and outside producers will, I imagine, ever extend the application of the latter, in which there is not, and cannot be, any sort of control—where the heat from the fierce combustion of the fuel fuses the ash into a hard slag, and renders it more difficult to clinker than the ordinary furnace, and at the same time subjects the fire-brick lining to the very rapid destruction, and where also the moderate supply of steam has absolutely no effect in economising either fuel or labor, or preventing the destruction of the furnace lining. Both the air and steam supply being under control in the inside producer, the temperature of the producer can be kept almost at a fixed point—viz., a dull red heat—and the heat can be so regulated that there shall be no clinker formed by the fusing of the ash, and practically no destruction of the furnace lining; while, at the same time, every particle of the combustible matter can be converted into gaseous fuel, and afterwards utilized for heating the settings.

The economy of gaseous heated retorts over old district coke-fired settings, which is now an admitted fact and beyond dispute, is as much due to this perfect control exercised over the process of primary combustion in the generator as it is to heating the secondary air supply in the regenerator by means of the waste heat passing from the settings. In the old system, the constant disturbance of the fires necessary to keep open the air passages, "tickling" the bars, raking down the fuel, and frequent clinkering, cause a large percentage of loss. Unconsumed coke and cinders tumble from the fire in the process of tickling, or are raked out with the clinkers and ash during scaling, and go away as refuse. In some extensive trials with settings of seven and five through retorts in a bed, consuming 28 lbs. of coke per 100 lbs. of coal carbonized, I have found that the refuse from the furnaces ranges from 27 to 48 per cent. of the coke consumed; the average being 34 per cent. As the coke contains about 10 per cent. of ash, it is evident what a very considerable loss there is from this source. Using the same coke in the regenator settings I have recently constructed in place of the ordinary settings above referred to, the consumption of coke works out at 14 lbs. per 100 lbs. of coal carbonized; and the ash refuse ranges from 18 to 20 per cent. of the coke consumed.

The difference in the working of the two settings is a saving of 50 per cent. in the coke used for fuel. Half of this saving I estimate is due to the more complete combustion of the coke in the generator, and the other half to the utilization of the waste heat in the regenerator for raising the temperature of the secondary air supply to 1,800° F. That this is so, I think the following figures will prove: The consumption of coke for fuel in the regenerator settings during 24 hours is 1.48 tons per setting of eight through retorts—3,315 lbs., or 14 lbs. per 100 lbs. of coal carbonized. Now, if the ash refuse from these 3,315 lbs. of coke were 34 per cent. (1,127 lbs.) as it is from the ordinary settings, instead of 18 per cent. (597 lbs.), as it is from the regenerator, the difference in these two figures (530 lbs.) would represent the combustible matter, or carbon, which in the one case is wasted amongst the clinker and ash, and in the other is utilized as a source of heat in the settings. When burnt to carbon dioxide, these 530 lbs. of carbon are capable of developing 7,708,320 units of heat. So much for the producer.

By means of the regenerator heated by the waste gases from the setting on their way to the chimney, the air for secondary combustion is passed into the combustion chamber at 1,800° F.; having picked up (say) 1,700° F. in transit through the regenerator flues. For the complete combustion of the producer gases, carbonic oxide and hydrogen, 20,555 lbs. of air will be required, which, heated to 1,700° F. by the waste heat escaping, carries back to the setting 8,295,587 units of heat, or almost the same amount of heat as the 530 lbs. of carbon above referred to are capable of producing. (For details of the calculations, see appendix.) It thus appears that, in regenerator furnaces of good construction, one-half the economy of fuel must be credited to the regenerative principle, and the other half to the efficiency of the producer.

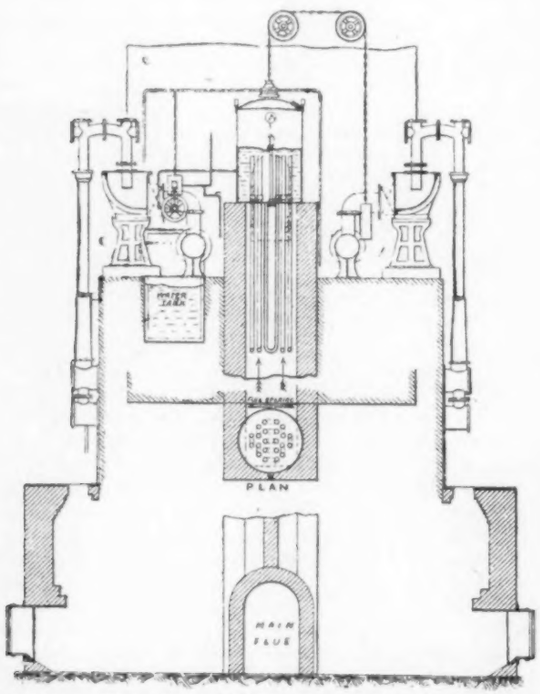
The economy of fuel in the regenerator settings represents a saving of 50 per cent., equivalent to 30 cwt. of coke per setting per day, which, at the current price of coke—viz., 12s. per ton—amounts to £6 6s. per week. There is also a further saving in labor of 20s. per week; making a total net saving of £7 6s. per bed per week. The efficiency of the producer in economizing fuel is due, as I have before shown, to the almost perfect combustion of the coke, which is burnt at low temperature—thus enabling the ash to separate as fine powder instead of being fused to a clinker; and this perfect combustion is again due to the complete control exercised over the air and steam supply for primary combustion.

The steam supply for the proper combustion of the coke fuel I have to deal with—viz., a cannel coke containing about 10 per cent. of ash, produced from the Nottinghamshire hard cannels—I have fixed at 876 lbs. per setting (two producers) per 24 hours. This is at the rate of 32 lbs. of water per 100 lbs. of carbon consumed, or 3.70 lbs of water per 100 lbs. of coal carbonized; with this quantity the coke is completely burnt without the formation of clinker. With the outside producer, and the same kind of coke fuel, I have used as much as 80 lbs. of steam per 100 lbs of carbon consumed: and even this large quantity had no material influence in preventing the formation of hard clinker by the fusion of the ash. The producers had to be clinkered twice in 24 hours instead of once as is the case with the inside producer; the fuel consumption was 20.8 lbs. per 100 lbs. of coal carbonized—an increase of 50 per cent.; and the labor was just double. The waste of fuel was principally due to the production of carbon dioxide instead of carbonic oxide in the producer, and to the quantity of unconsumed coke, which, in the process of frequent clinkering, was mixed up with the slag refuse, and wheeled to the tip.

I have never seen any reliable figures quoted as to the quantity of steam found to be sufficient for preventing the formation of slag in the outside producer. Mr. Foulis, in 1883, stated, in a general way, that the steam used in 34 producers did not appear to appreciably increase the fuel used under their boilers; but I venture to think that if a more careful observation were made it would be found to be not an inconsiderable amount. Mr. Emerson McMillin, of St. Louis (U. S. A.), in 1885, made some interesting calculations as to the proper supply of steam which can be used with advantage in producer furnaces; and he came to the conclusion that we can both "save fuel and gain intensity of temperature by the use of about 40 pounds of water vapor per 100 pounds of carbon consumed, when the coke is burnt in a deep producer furnace, and the gases are consumed in the combustion chamber of the setting and around the retorts." With the inside producer I have experimented with steam in all proportions, ranging from 10 to 40 pounds per 100 pounds of carbon; but have found the most satisfactory combustion to take place when the steam used is 32 pounds per 100 pounds of carbon. With different fuels the proportions will naturally vary in accordance with the percentage of the ash they contain. The larger the quantity of ash, the less steam required.

The heat abstracted from the fire by the decomposition of 876 pounds of steam is rather more than 11,000,000 units; or the same quantity of heat is absorbed which would be developed by the combustion of 97 pounds of hydrogen gas—*i.e.*, the proportion of hydrogen which is contained in the 876 pounds of steam. This heat is not wanted in the producer. Without it there is sufficient heat to convert the fuel into gas; and its presence would tend materially to increase the wear and tear and the destruction of the furnace lining. None of it is, however, lost. It is merely abstracted from the producer, where its presence would be harmful, and restored to the setting in the combustion of the gases: thus increasing the temperature around the retorts where most required, and converted into useful work. I have here a sample of the ash produced, which I think you will find contains no particle of combustible matter or clinker; showing that fusion has taken place.

The object to be attained in the use of steam is to prevent the formation of clinker; and this is accomplished without sacrifice of heat and with distinct economy in the wear and tear of the furnace, and in labor necessary for cleaning the fires of ash. Having shown the quantity of steam necessary to do this with the greatest advantage, the question now is how the same can be produced with the least expenditure for fuel. In some of the more complicated German settings the steam is produced in cast iron cylindrical boilers placed in the flues of the descending gases. This arrangement is very defective; since only the lower half is covered with water, and the heat first strikes the cylinder on the upper side, thus causing the rapid destruction of the boiler. Another form of generating steam is by carrying the waste gases under a wrought iron ashpan supplied with water. This also is a form subject to rapid destruction by be-



Chester's Water Tube Steam Boiler Heated by Waste Gases.—Area of Heated Surface, 30.45 sq. ft. Water Evaporated, 1,300 gallons per 24 hours at 20 lbs. pressure.

ing burnt out when the water supply fails through some transitory neglect on the part of the fireman. In some of the cruder furnaces water is allowed to trickle down the fire bars and thus become vaporized; but in this arrangement the bars rapidly become oxidized and destroyed. In all these systems the vaporization which takes place is arbitrary and under no sort of control; and the economy gained by the utilization of waste heat for raising the steam is more than counterbalanced by the wear and tear on the vessels used. A better plan is to take the steam supply direct from the boilers, and thus be able to use it under proper control and in the proportion adequate for the requirement of the fire; but this means an extra expenditure in the form of fuel. Having had all these systems in operation and experienced their disadvantages, I have devised a means of generating steam which combines all the economy to be obtained from utilizing the heat of the waste gases, places its supply under perfect control, and possesses none of the drawbacks of extravagant wear and tear.

I have devised a water tube cylindrical steam boiler, fixed vertically 3 ft. 6 in. in diameter, having fixed in the bottom plate steel tubes each 2 inches in diameter, bent to a semicircle at the bottom, and having a long and a short leg inside the boiler. The long and the short leg are for the purpose of giving direction to the circulation of the water. The boiler which is shown on the accompanying drawing is fitted with the usual steam gauge, water gauge, safety valve, blow-off cock, etc., and is placed on top of the vertical main flue of the settings leading to the chimney, and the water tubes hang in the flue. In case of mishap to any of the tubes I have provided means by which the boiler can at once be lifted from its seat, and raised so that the tubes are clear of the heat.

The ascending waste gases are made to play round the water tubes, and a rapid generation of steam ensues. The boiler receives the waste heat from eight settings of retorts, and supplies steam to twelve settings. It is fed by a donkey pump worked by its own steam, and the generation of steam is very regular at 30 pounds pressure at the rate of 1,200 gallons of water per 24 hours. The boiler is under the control of the retort house foreman and one of the firemen, and requires very little attention—merely having to be supplied with water once in every 1½ hours. The steam is taken to each furnace and admitted through a small nozzle about ¼ in. in diameter, and regulated by means of a cock. The steam formerly used for these settings required a consumption of 15 cwt. of coke per day, or 5 tons 5 cwt. per week—value, £3 3s.; which sum represents the saving effected by a capital outlay of something under £100.

In this way I venture to think I have carried the economies of regenerator firing a step nearer to the goal of perfection.

[APPENDIX.]

Statistics as to the Working of One Regenerator Setting, containing Eight Through ◘ Retorts, each Eighteen Feet Long, in a Bed.

TWENTY-FOUR HOURS WORK.

	T. C. Q.	
Coal carbonized	10 11 1	
Coke and breeze produced for sale	5 9 2	= 10.37 cwt. p. ton coal carbonized.
Coke consumed for fuel	1.48 tons	= 3,315 lbs. = 14 lbs. per 100 lbs. of coal carbonized.
Ash refuse from fires	597 lbs.	= 18 per ct. of coke consumed.
Water used as steam for fires		= 876 lbs. per 100 lbs. of coal carbonized, or 32.2 lbs. per 100 lbs. carbon consumed.

Details of Calculation Referred to in Paper.

ONE SETTING OF EIGHT THROUGH RETORTS—TWO FURNACES.

Ash refuse from ordinary setting, 34 per cent	1,127 lbs.
Do. regenerator, as above, 18 per cent	597 "
Difference	530 "

The difference represents unconsumed carbon wasted amongst ash and clinker brought away from ordinary setting.

530 lbs. C × 14,544 units of heat = 7,708,320 units of heat.

Combustion in producers—

	Lbs. Combustible Matter.
Coke, 3,315 lbs., less 18 per cent. ash refuse, 597 lbs	= 2,718
2,718 lbs. of combustible matter, consisting of 96 per ct. of carbon	= 2,609
4 per cent. of hydrogen	= 109
876 lbs. of water vapor, 779 lbs. of oxygen and 97 lbs. hydrogen	= 97

	Percentage of Producer Gases by Volume.
2,609 lbs. C., 10 per cent. to CO_2 = 261 lbs. C + 696 lbs. O = 957 lbs. CO_2	= 3.20 CO_2
90 per ct. to CO = 2,438 lbs. C + 3,131 lbs. O = 5,479 lbs. CO	= 28.79 CO
Hydrogen from coke 109 H	= 15.15 H
Do. do. water vapor 97 H	
Nitrogen from air 10,062 N	= 52.86 N
	100.00

Air required for secondary combustion of producer gases—

Lbs.	Lbs.	Lbs.
5,479 CO	+ 3,131 O	= 8,610 CO_2
206 H	+ 1,648 O	= 1,854 H_2O

Secondary air required = 4,779 O + 15,776 N = 20,555 lbs.

Then 20,555 lbs. of air heated 1,700° F. = 20,555 lbs. × 1,700° × 0.2374 specific heat of air = 8,295,587 units of heat.

	Units of Heat.	Per Ct.
Heat restored to setting due to regeneration	= 8,295,587 =	51.8
Heat due to combustion of 530 lbs. of carbon saved in producer	= 7,708,320 =	48.2
Total saving effected, due to regeneration and producer	= 16,003,907 =	100.0

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, DEC. 10, 1890.

Accidents at Gas Works.—London Electric Light Companies.—Rights of Gas Companies as to Stopping Supply.—The Manufacture of Gas Appliances.

The general public usually exhibit in a greater or less degree doubt as to the safety of a gas works as regards liability to explosion, or poisoning by escape of gas, and many believe them to be most risky and unwholesome places. I have heard on good authority that a man employed at a gunpowder manufactory preferred to take a circuitous route rather than follow a road that would lead him to the close vicinity of a large gasholder. Gas engineers laugh at such apprehensions as ridiculous and point to statistics as showing that a gas works is a safer place than an ordinary public thoroughfare. When we consider the number of gas works in England alone—there are nearly 400 statutory undertakings, several of which own more than one "station," besides two or three times as many smaller works for the supply of country towns and villages—and the number of men employed in the various kinds of labor concerned, it would be absurd to expect absolute immunity from accident, and the fact that so few occur is a proof of the system and regularity with which operations are conducted. Public attention has been directed to this subject by an accident at Middlesborough, which resulted in the total suspension of the gas supply for several hours; and the unfortunate occurrence has been eagerly seized upon by those who endeavor to make capital for the electric light on the score of safety as compared with gas, and who prefer to ignore the fact that for every electric lighting installation in practical operation, there are at least 100 gas works. The accident in question consisted of the utter collapse of the exhauster house. This building comprised 4 walls, each 1½ bricks thick, forming a rectangle 36 feet × 34 feet, and 14½ feet high. They formed a support for a cast iron tank, 4 feet deep, containing gas pipes, which was used as a water condenser. It was supported on 8 strong cast iron girders, the ends of which were built into the walls, and the weight of the whole approached to 200 tons. During the small hours of the night, when no one was near the building except the man in charge of the engines, the wall fell outward letting the heavy tank down on the machinery, killing the man, and demolishing the whole. Opinions differ as to whether the walls simply gave way under the heavy weight of the tank, or a gas explosion occurred in the building first, and so brought about the disaster. The majority incline to the latter view, which is supported by the fact that portions of the glass from the windows, broken in very small pieces, were scattered about the works. Against this it may be urged that if the force of the alleged explosion was relieved by blowing out the windows, the walls should not have been shaken. Be that as it may, the plan of placing such a heavy weight, dispersed over such a wide area, upon four walls running under the outer edges of the tank, does not commend itself as worthy of imitation. Instances of explosions of gas that have actually moved the walls of a building are extremely rare, and it seems probable that the design of the structure contributed in some degree towards causing the accident.

A strange and sad fatality has happened at Galbourne gas works. The manager of the works, together with a workman, got into a tank used for storing ammoniacal liquor, which which was situated in a building, near the roof, and supported on rafters. Both were overpowered by noxious gases. and rushed to the side, when the man tumbled over on to the floor below, but the manager fell backwards inside the tank. A neighbor who was passing bravely went to his assistance and endeavored to lift him out, but was himself overpowered, and both were dead before they could be removed from the tank, being suffocated by carbonic acid and ammonia gas that had accumulated. Deaths due to poisoning from entering tanks or other vessels used for containing gas or ammonia water, form no inconsiderable part of the fatalities connected with gas works, and suggest the idea that sometimes poisonous gases arrange themselves in strata or masses, and obstinately retain a position either at the bottom or at the top of the containing vessel, according to their specific gravity in comparison with air. The circumstances attendant upon some explosions of gas support the view that the gases will accumulate in a convenient corner, and resist the action of diffusion which proper ventilation is supposed to secure, for a considerable time.

No less than eight companies have been established in London and its suburbs for the purpose of supplying electric lights. The largest has a paid up capital of £650,000, and the next £200,000. A writer in a recent issue of the *Electrical Review* deals with the fact that not one of these undertakings is yet in a position to declare a dividend. Two of the companies estimate that the working expenses, repairs, depreciation, etc., amount to one-half of the total receipts, and on the basis of this estimate the writer examines the position from a business point of view. Some of these undertakings have now been in operation for a sufficient time to admit of much closer figuring than the above very broad estimate, and it is surprising that more accurate details should not be forthcoming. The conclusions based upon such uncertain foundations are of no value at all. As the price charged for the electric light is equal to 7s. to 8s. per 1,000 cubic feet of gas, or say almost three times the cost of gas as at present supplied in London, it would appear that the working expenses alone are considerably greater than the cost of gas, and, therefore, that there is no possibility of electricity competing with gas in the matter of cost. Speaking of electricity, it is worth while to note that the arc light appears to be giving place to the incandescent. The cold color and unsteadiness of the arc, together with the cost of renewing the carbon pencils daily, may have something to do with this. From various statistics I have been able to gather, it would appear that the expense of the latter item alone would be sufficient to maintain a large sized gas light, giving 100 or 150 effective power.

A recent decision in a court of law, awarding £15 damages to a consumer, as a consolation for injury sustained by the action of the gas company in entering upon his premises for the purpose of cutting off the supply of gas, has attracted considerable attention. The consumer would not pay his bill, and the company were therefore not inclined to incur risk of further loss. If a private tradesman wished to cease doing business with any person whom he had reason to believe was not trustworthy, or had proved troublesome in previous dealings, he would consider it a great hardship if the law compelled him to follow a circuitous course that not only involved considerable trouble, but also placed his customer at a great disadvantage. And it seems absurd that a trading company should not also be allowed to enjoy equal facility for protecting itself from loss. Many gas companies are so loaded with regulations limiting the hours during which they may cut off the gas, or forbidding them to do so without two or three days previous notice, that they are entirely at the mercy of any unscrupulous person who is not inclined to pay his debts, or to defraud them in other ways. We are promised some new legislation with the coming year, that will render the defrauding of creditors a more difficult matter than it has been in the past. The Gas Light and Coke Company intend to apply to Parliament for powers that will in effect place them in the position of a private tradesman, and enable them to close any account without notice, where good reason exists for so doing. It is to be hoped that this action will direct attention to the rights of gas suppliers in the matter of protection from persons who do not pay their bills. In pointing out these facts, I do not hold up the fortunate recipient of the £15—who would no doubt be delighted to have the gas cut off on similar terms, at frequent intervals—as a specimen of the fraudulent or dishonest class, or enter upon a discussion of the reasons why the bill was not paid in this particular case.

I notice that some of the members of the American Gas Light Association are not quite satisfied as to the position of the gas appliance industry as regards the nature and price of the stoves, etc., that are put upon the market. There is room for a little grumbling on that score over here also. For one thing the principal makers seem to feel it incumbent to bring out a lot of new designs each year, and some do so even more frequently. No one wishes to check enterprise in this direction, and provided that each novelty is a distinct advance upon its predecessor, the more rapidly they come the better. But the thing can be carried too far. Too great a variety only bewilders the consumer, with the result, perhaps, that he does not get the article best suited to his wants. A very large show room is necessary in order to set out a really good representative set of gas appliances, and this, coupled with the fact that the novelty of two seasons back is now antiquated, and people won't have it at any price, renders it difficult for gas companies or gasfitters in a private way of business to avoid loss in the shape of unsalable goods left on hand. It is also difficult for a gas engineer to make himself as familiar as he should be with the capabilities of each kind of apparatus. Examples of several different varieties of "patent" stoves or gasfires might be instanced in respect to which it would be difficult to define where the "patent" lies as between one and another. Surely, it would be better if the methods of securing the best possible results, either in the way of warming or cooking by gas, could be simplified and defined. With so much variety all cannot be right.

Apart from this I have nothing but praise. The enterprise exhibited in regard to the design, the workmanship, and the price of many gas stoves and fires on the market is commendable. No one in this country would find it advisable to set up the manufacture of such things for themselves. The objections inseparable from the older forms of apparatus have

gradually been remedied. The proper way of securing complete combustion, the question of ventilation, the advantage of a radiant heat thrown out from a red-hot solid surface, as compared with the convected heat from a close stove, and many such like considerations, have received proper attention, so that, provided care is taken to secure the right apparatus and to have it fixed in the right manner, no trouble is experienced with the working, nor is there any risk of profane language when the gas bill is presented.

[A Paper read before the Engineers' Club, Philadelphia.]

Pump and Methods Used for Grouting the New York Aqueduct.

By Mr. P. F. Brendlinger.

About the month of March, 1888, the contractors for the construction of the new Croton aqueduct for the city of New York commenced to repair defective work in the aqueduct. One of these defects was a lack of cement mortar in the rubble masonry between the arch and the surrounding rock. The contract forbade the use of grout in the construction of the work; but for some reason or other, not necessary to mention here, grouting was resorted to to remedy the defective backing.

At first large funnels, specially constructed for this purpose, were used as a means to carry the grout through the brick walls and deposit it in the backing. The brick lining is, as a rule, 12 inches thick. Through this lining holes about 2 inches in diameter were drilled, into which the spout of the funnel was introduced. The receiver of the funnel was vertical—*i. e.*, the discharge pipe and receiver were at right angles to each other. The funnel was made from ordinary commercial tin, and had a capacity of a common pail or bucket. The cement and sand were mixed at the top of the shafts in the proportion of 1 to 1, and lowered in buckets holding about 6 barrels of mixture. At the bottom of the shafts the mixture was dumped on a platform, then shoveled into barrels and loaded on wagons with solid wooden wheels 30 inches diameter and 4 inches thick, the tread being beveled to correspond to the invert. One wagon would hold 9 barrels, which was then drawn to the place of grouting by one mule. About 3 barrels of this dry mixture was then placed in a box, and water added to make a mixture about the consistency of cream; this then was bailed out of the box and handed to a man standing at the funnel, who would pour it into the funnel until the hole refused to take any more.

This method of grouting was continued about two weeks, when the city engineers ordered the contractors to cease the use of funnels and resort to pumping in the grout. The contractors, in their usual docile spirit, acquiesced very gracefully, and looked about the market for a suitable pump that could do the work. After a long and careful search an ordinary double-acting, deck fire pump, manufactured by W. & B. Douglas, Middletown, Conn., and costing complete, with all the fittings, about $90, was adopted.

The pump was usually bolted on to a narrow truck about 3 feet wide, having wooden wheels about 20 inches diameter, and was just long enough for the men to stand on when working the pump. The pump was placed about the center of the tunnel, and the grout box on either side. A suction hose (2½ inches diameter), varying from 6 to 9 feet in length, was connected with the pump on one side, and the other end placed into the grout. The discharge hose, 2 inches in diameter and 20 feet long, was connected to the pump opposite the suction hose. The pump could grout a section about 50 feet in length without moving the box. The discharge hose was fitted with a nozzle of ordinary 1¼-inch gas pipe, about 15 inches long, which was inserted into the holes drilled into the brick arch. The discharge hose was guaranteed to stand 200 pounds pressure per square inch; a few of the hose burst. Several tests were made at the nozzle of the hose with an ordinary steam gauge, and, while not altogether satisfactory, a pressure of 110 pounds was obtained.

Method of Grouting.—An important feature of the grouting was to know where to place the drill holes so that the maximum effect of the grout could be attained, or, in other words, to be certain that the whole defective work would be grouted. To derive this knowledge it was necessary to go back and ascertain how this work was originally built. This was found to be as follows: There were eight courses of brickwork laid in the side walls, then the work stopped until the space between the brickwork and rock lining was filled with rubble masonry, then eight more courses of bricks were laid, and the space behind filled with rubble masonry, and this operation was repeated to near the key. In cutting into the side walls it was discovered that wherever the rubble backing was found to be defective or having a lack of mortar, there was generally a heavy coat of mortar over the entire backing at the level of the 8th, 16th, 24th, 32d, etc., courses, so that no grout could rise above the layer if put in below. It was, therefore, decided to consider the defective work as lying in channels about eight courses high, into which grout would have to be injected separately. Drill holes were therefore placed at the following courses, viz., the 6th, 14th, 22d, 28th, 36th, 45th, 51st, 60th and 67th, and 75th or key.

The holes were drilled every 10 feet, but were staggered, that is, at one station the 6th, 22d, 36th, 51st and 67th were drilled, and 10 feet beyond the 14th, 28th, 45th and 60th and 75th were drilled. This was done for several reasons. One was it would not disfigure or weaken the wall as much as drilling them all at one place; and, again, as these 10 holes would cover a space 20 feet in length, it would be better to grout half the number of holes every 10 feet than to grout the whole number of holes every 20 feet, as occasionally a course of cemented work would intervene in a distance of 20 feet. A system had to be adopted so that the foreman and laborers in the tunnel could work intelligently and records kept accurately.

The drillers would, as a rule, keep about 300 feet ahead of the grout pump, so that in case a cavity behind the arch would be disclosed by the drill, a hole about 18 inches square would be cut through the brickwork and the cavity filled with the proper material. The photograph taken at station 447 x 50 east wall shows the channels of defective masonry and the coat of masonry far better than the best description.

The plan accompanying this also shows the form of tunnel, the courses of brickwork from the intersection of the side walls with the invert to the key, the thickness of brickwork, the position of the drill holes longitudinally and transversely, also the backing behind the arch with the coating of cement mortar every eight courses.

About 15 per cent. of the 13 miles of the tunnel under my charge has dry packing above the 55th course, or above a tangent to the extrados of the key, which, of course, was not to be grouted. To be certain that no grout would go into the dry packing tell-tale drill holes were put through the arch at the 55th course, 5 feet on each side of the grout hole, and instead of drilling the regular 51st course the 49th course was drilled, so that the grout would not first enter the dry packing, and as soon as the grout ran out of the tell-tale holes the pump would be stopped. Frequently the pump could grout a space 50 feet long into one hole, the grout running out of most of the holes for 25 feet each way. These holes would be temporarily closed up with wooden plugs kept on hand for the purpose. These holes would all be subsequently opened again, cleaned out and the pump tried on them. About 10 per cent. of them would take grout again. About every 20 feet on each side of the tunnel weepers or drains were built behind the arch opening through the brick side walls at the bottom. These had all to be closed up with bricks and mortar until the grouting was finished, or else the grout would run out into the tunnel as fast as pumped behind the arch.

Labor Used.—Seven men constituted a grout gang—1 forman, 4 men on the pump, 1 hoseman, 1 stirrer or agitator. When the pump commenced to work hard, the foreman and hoseman would both "lend a hand," making the grout go in or burst the pump. The maximum amount pumped in one shift of 10 hours was 280 barrels of mixture, representing 120 barrels cement. The largest number of barrels of grout pumped into one hole was 865, then the pump was stopped. For all we could tell, Westchester county was being filled through a fissure in the rock. One hundred barrels of mixture pumped in as grout constituted a fair or average day's work of 10 hours, and toward the completion of the work 15 or 20 barrels were all that could be done on account of so much shifting of the pump and grout box, the holes generally refusing grout.

Number of Pumps Used.—The greatest number of pumps in use at one time was 23, forcing in about 2,326 barrels of mixture in the form of grout, representing 1,000 barrels of cement and 1,000 barrels of sand, the standing order for cement being 800 barrels.

We had altogether 27 pumps on hand, keeping 3 or 4 extras ready to take the place of break-downs.

The total number of barrels of cement used in grouting was about	165,000
Amount of sand used	165,000 barrels.
Amounting to a total of	330,000 barrels,

before mixing, which when mixed dry made 382,800 barrels (1 barrel cement and 1 barrel sand making 2.32 barrels of dry mixture). This when mixed with water and converted into grout made 317,000 barrels.

Conclusion.—The pump used for this work unquestionably did the work, and that with perfect satisfaction so far as the quality and thoroughness of the work were concerned; but in my opinion there are far better pumps in the market that are better suited for such work, doing the work more economically and with greater rapidity. Before

work of any kind is done a contractor calculates the magnitude of the same and arranges his plant accordingly. So it is with repairing work. He should first determine the extent of his defective work, which can be done very closely in various ways, then arrange his plant.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE Second General Meeting of the American Chemical Society will be held in Philadelphia to-morrow and Wednesday. The meetings will be held in the Chapel of the University of Pennsylvania, under the direction of the President, Prof. G. F. Barker.

AT the annual meeting of the Oneida (N. Y.) Gas Light Company, the following officers were chosen: President, W. E. Northrup; Secretary and Treasurer, H. S. Klock; Superintendent, P. Clark; Collector, R. A. Hill; Directors, the Hon. Geo. Berry and Messrs. D. H. Walrath, S. H. Farnum, H. S. Klock and W. E. Northrup. A regular semi-annual dividend of 3 per cent. was declared payable on and after January 5th. The Company's business for the year just closed was of the most satisfactory nature, and it enters upon the last decade of the century in better shape than at any other portion of its history.

THE new pulp mill of the Manufacturing Investment Company, at Madison, Me., is fast approaching completion. The buildings, which are of iron, were designed and erected by the Berlin Iron Bridge Company, of East Berlin, Conn.

THE Cooperstown (N. Y.) Illuminating Company has been incorporated by Messrs. Dudley Farlin, David S. Mann, James E. Noble, Allan R. McDonald and Frank L. Thompson. It is capitalized in $50,000, and the projectors propose to construct a gas works in Cooperstown, the same to be completed at as early a date as possible. This would seem to show that the Edison incandescent electric lighting system is not in very great favor with the residents. A plant of that type equal to the maintenance of 1,750 (16-candle) lamps has been operated there for some time by the Cooperstown Light and Power Company, which also at one time carried on a rather indefinite system of gas manufacture and supply, following the Hanlon Method.

A MOVEMENT is on foot to place a gas works in the beautiful town of Glen Cove, L. I., and mention of the fact that such a scheme is under way makes it seem all the more strange that a gas works had not been installed there long ago. Glen Cove is about 28 miles east-northeast of Brooklyn, and is on a branch of the Long Island Railroad system. It is also accessible by water, through an estuary of Long Island Sound.

A TRIAL of the Newell system of gas manufacture is going on at the New Jersey State prison, Trenton, N. J.

THE new holder for the Pekin (Ills.) Gas Company is completed and in satisfactory working order. It has a capacity of 60,000 cubic feet.

AT the annual meeting of the North Attleboro (Mass.) Gas Light Company the following officers were chosen: President, Abiel Codding; Secretary and Treasurer, Charles H. Randall; Directors, Abiel Codding, H. F. Barrows, J. O. Lincoln, Joseph G. Barden, B. S. Freeman, H. F. Barrows, Jr., and Ira Richards. Mr. W. B. Knight was chosen Superintendent. The officers are the same as those who served last year, save in the instance of Mr. J. D. Lincoln, who is named to the vacancy in the Directorate caused by the death of Mr. J. D. Richards. The Company is gaining all the time.

A GAS main that runs along the Pennsylvania Avenue Bridge at the Eastern Branch crossing, Washington, D. C., sprang a leak, on the evening of December 17th. The gas became ignited, and before the danger was discovered quite a large hole had been burned in the footway.

AT the annual meeting of the shareholders of the Columbia (Pa.) Gas Company the following officers were chosen: President, Jas. A. Myers; Managers, H. M. North, H. F. Bruner, Joseph H. Black, C. E. Graybill, M. S. Sherman and W. B. Given.

PRESIDENT DEXTER HORTON informs us that the stock of the Seattle (Wash.) Gas and Electric Light Company (amounting in all to $200,000) has been transferred to the Seattle Gas, Electric Light and Motor Company.

THE electric plant of the Hamilton (Ohio) Gas Light and Coke Company has been enlarged recently. A feature of the plant is a 50-horse power gas engine that actuates a 1,500 light incandescent dynamo service.

SUPERINTENDENT MCCOLLUM, of the Riverside (Cal.) Company, writes that that Company is gradually but steadily extending its field of operations and usefulness by enlarging and adding to its main system. He also forwards us a copy of the *Enterprise*, which contains an account of the work that is being carried on by the Company, and the editor of the *Enterprise* concludes his narration in the following words: "The Riverside Gas Company is an all-home Company, full of enterprise and the proper spirit that goes to build up a town. Would we had more such wide-awake people among us." There must be something really wonderful about the "climate of California," when the local editors that are subject to its influences can find it in their pens to say good words for the gas interest.

THE National Tube Works plant at McKeesport, Pa., is to be greatly enlarged, and not the least important feature in the scheme is the installation of a plant for the manufacture of gaseous fuel for use in the butt weld department of the Company.

THE following officers have been chosen by the Directors of the Consolidated Gas and Electric Light Company, of Annapolis, Md.: President, W. H. Bosley; Secretary and Treasurer, Theophilus Tunis.

THE Boston *Herald* says that last October the Boston Gas Light Company began employing students to take the statements of the meters at the close of each month, and to deliver the bills the following week. The idea originated with the Company and not with the students seeking employment, because when men were employed they had to be taken into regular employ and paid just the same after the meter statements had been taken, whether there was enough work for them to equal their wages or not! Or if men were taken from the regular working force, the work on repairs fell behind. Since it takes but about five days to read the meters and two to deliver the bills, the idea was to get men who could work for that period for ordinary day wages ($2), and whom it would not be necessary to employ after that special work was done. Wage earners naturally could not engage themselves under such conditions, and the only class that seemed available was college and high school students. Accordingly the advertisement was published and applications came in fast, so that there has already for some time been a considerable waiting list. The young men are from various schools—the English High, Somerville High, the commercial schools in town, Boston University and Harvard. The students at the Institute of Technology cannot come in for their share of the employment, since they cannot cut lectures, and during the monthly period for reading the meters the employees must work all day, just as wage earners do. About 25 men are employed in going the rounds, and although the pay is neither high nor constant, it is regular and certain, and helps to eke out a poor fellow's means when he is trying to earn an education for himself. Some fears were felt at first that students would not be fitted for such employment since they have all kinds of places to go into, and, if ruffled by snubs and disagreeable treatment, they might reply impertinently. It is true that complaints have reached the gas office from consumers; but according to Mr. Blanchard, who has charge of that department, the work is being more and more satisfactorily done, and the experiment is regarded by him as a real success. Sometimes a student "makes time" on his rounds, but he is at once told that the same ground has been covered in such and such time, and thereafter it does not take him so long. Mr. Blanchard feels a thorough interest in the plan, since it is not only of advantage to his Company, but a great assistance to poor students.

CONSIDERABLE damage was done by a fire that broke out in the engine room of the Grand Forks (N. D.) electric light works. Spontaneous combustion in a pile of oily waste was the cause. The electric plant adjoins the gas works, but no damage was occasioned the latter.

THE Directors of the Cleveland Gas Light and Coke Company have decided to erect a handsome modern building on the present site that has served them with office room since 1869. The structure will be commenced in the spring. It will occupy all of the 35 feet between the City Hall building and the Arcade Hotel, will have a depth of 80 feet, and a height of 80 feet, reaching to the base of the mansard roof of the City Hall. It will have four stories. The basement is to be used as a work shop. The main offices, which will cover the first floor, will be entered from a small flight of steps from the street level, and the plans for laying out the counting rooms and the furnishing of the same are both elaborate and ornate. To the rear of the main office will be a staircase connecting it with the office of the Chief Engineer, in the second story, and the rooms on the other floors will be appropriately alloted to the officials

and clerks. The Company will not rent out any portion of the building. Stone and brick will be the materials out of which the front will be constructed, and the building will be fire-proof as to the basement and first and second stories.

A VERY interesting joint session of the Wheeling (West Va.) Council Committee on Lights and the Board of Gas Trustees was held recently, the object being to receive reports from the sub-committees intrusted respectively with the tasks of determining the number and location of high-power arcs that would be necessary for the lighting of the city, and the cost of installing an electrical plant, together with the annual cost of maintaining the same on municipal account. Mr. Farrell occupied the chair and Secretary Franzheim recorded. The sub-committee on number and location of lights reported that 359 arcs would be required to light the city, and that in their opinion provision should be made for the installation of a 400-light (2,000-candle power arcs) plant. After some discussion as to whether 2,000 or 1,200-candle power lamps should be employed (it was unanimously determined to adopt the 2,000-candle class), Secretary Franzheim submitted the following approximate estimates for the plant from the named contracting Companies, many of which were represented by their agents at the hearing. The highest estimate was that from the Westinghouse Company, of Pittsburgh, which contemplated the expenditure of $101,250. This called for eight 60-light dynamos. Buildings were put at $5,000; steam and electrical machinery and apparatus, including boilers and all connections, $55,000; 75 miles of line in position, at $550 per mile, $41,250. The Westinghouse Company believed the expenses of running such a plant would "be well within the present cost of lighting the city by gas." The Fort Wayne Electric Company submitted an estimate footing up $84,000, the items in which were: Engines and boilers, 450 horse power, $21,000; 50 miles of wire, at $300 per mile, $15,000; dynamos and lamps (400), $32,000; 400 mast arms, 26 feet in length, $10,000; shafting, etc., $1,500; building, $5,000. Cost of operating was put at 14 cents per lamp per night. The Western Electric Light Construction Company, of Chicago, submitted a gross estimate of $61,000, divided as follows: Building, $4,000; engines and boilers, $15,000; apparatus, $24,000; 60 miles of circuits, at $300 per mile, $18,000. The cost of operating, including every kind of expense, was put at $14,415 per annum. The Thomson-Houston Company submitted an estimate on a 200-light plant, on a total basis of $40,000, and asserted that the cost of operating same would be $12,430 per year. That estimate expanded to support 400 lights would cost about $60,000. Mr. L. N. Cox, of the National Electric Manufacturing Company, Washington, D. C., estimated the cost of installing a 400-light plant of 2,000-candle lamps would be not to exceed $76,000, and he put the cost of operating at about 10 cents per lamp per night. The Edison Company estimated that the cost of operating a 400-light (2,000-candle) plant would be $11,700 per year, exclusive of interest on investment and wear and tear, but did not submit figures as to installation cost. All the estimates having been placed before the Committee, Mr. Young, of the Western Electric Light Construction Company, was called upon to explain his bid. He said his figures included two 400-horse power Corliss engines, either of which would be capable of running the plant in case of an accident to one of them; the boilers would have 500-horse power. The plant would comprise nine 50-light dynamos, eight of which would nominally be equal to the furnishing of the light, but a ninth was necessary, so that, in case of accident, the defective dynamo could be cut out and the extra one switched on. Another reason for having an extra dynamo was that as the Wheeling circuit would be a very long one—at least 60 miles—not more than 45 lights would be yielded by a 50-light dynamo. His Company would suspend lights over the centers of street crossings, at a height of 35 to 40 feet from the ground. The total of $61,000 would mean an average total expense on every account per year of $36 per light. The total cost was largely a matter of line. He had estimated for 60 miles, but that could be increased or diminished by adding or subtracting $300 per mile. Mr. Ingolls, representing the Westinghouse Company, was asked to explain the bid of his Company, but declined, asserting, however, that when the Committee was ready to proceed to actual business he would have all the data. Mr. Robinson then submitted a resolution instructing the Secretary to transmit to Council a report of the work done by the joint body, with the information that from the data obtainable a 400-light plant was desirable, and would cost about $80,000, allowing for all contingencies. The resolution was adopted.

To the courtesy of a correspondent we are indebted for the following details respecting the newly constructed gas works at Bellingham Bay, Washington: "Early yesterday morning (December 8th) an announcement was made that gas would be turned on to the mains of the Bellingham Bay Gas Company, and that evening about all the residents of Fairhaven passed by the corner of Twelfth and Harris streets, where a handsome specimen of the Siemens-Lungren burner was shedding its mellow and handsome light. Many of the stores and private residences were illuminated with gas for the first time, and general rejoicing was indulged in over the practical inauguration of an enterprise that marks an important step in the advance of the towns that nestle on Bellingham Bay. The history of the new venture is about like this: During the month of February, 1890, Mr. M. G. Elmore, who is well known in San Francisco gas circles, secured a contract for the erection of a gas works at Port Townsend, and while at the latter place Mr. Elmore heard of the enterprise, growth and progress of Fairhaven, and concluded to visit the Focal City. After his arrival here Mr. Elmore conceived the plan of lighting all the Bay cities from a gas works located at a central point, and with this idea in view he associated himself with Mr. Geo. E. Brand, the present energetic Secretary of the Company. In a short time thereafter franchises were secured from the authorities of all the Bay cities for the right to supply gas therein, the last sanction having been obtained in June. With the necessary consents obtained a Company known as the Bellingham Bay Gas Company was formed, with the following list of officers: President, H. Y. Thompson; Vice-President, Captain E. Eldridge; Treasurer, E. M. Wilson; Secretary, Geo. E. Brand. The officers are all Trustees of the Company, and its office is located in Mason Block, Fairhaven. The members of the Company are all well-known residents of Bellingham Bay, and are interested in many of the important enterprises which tend to increase the prosperity of this vicinity. The capital of the Company is $250,000. In July a contract was entered into by the Company with Mr. Elmore, for the construction of the works complete to lighting, including the laying of 8 miles of pipe, the placing of 150 meters, etc., etc. Four lots centrally located between the cities were bought, and on the first day of August, 1890, the work of construction was begun, and it is needless to say that Mr. Elmore, under whose supervision the work was conducted, is entitled to great credit for the speed shown in its completion—nor was it in any sense over-hurried or slighted. The works are situated on a plot at the corner of Front and Monroe streets—35 feet on Front and 160 feet on Monroe. The retort house is 35 feet square, with an iron, trussed roof and the apparatus therein, as well as that in the condensing and purifying house, etc., is all of the best description, and is put together and arranged in accordance with the approved practice of the day. The gas holder (capacity of 60,000 cubic feet) is arranged so that its storage capacity can be increased by the addition of a lift, when the demands for gas shall have reached the desired point. By the addition of a gas-holder on the line of Whatcom and Sehome, these towns could be supplied with gas from the Fairhaven plant. A 24-candle gas is sent out, and the Company carbonizes coal from the South Prairie mines close by, using Australian shale as an enricher. While all this may not be very exciting to the readers of the JOURNAL, it nevertheless has much of interest to the fraternity of the Pacific coast, and more particularly to the fraternity resident in the Great Empire that is rapidly taking on definite form in the States of Washington and Oregon."

"THE coward shows his nature when the shadows close in; and so it is with the Massachusetts coward, who is principally the alien with a labor grievance. The grievance, of course, is largely, if not wholly, of his own making; for when he held the field, no one was his master—not even himself. A wholesome restraint has saved many a nation; but labor will never seemingly learn that the restraint imposed upon it by kindly and humane capitalists is not the leash of servitude, but the sober guide that would protect it from itself. If brain does not dominate, can brawn and muscle rule? No, you answer; and with truth—not for any length of time, if the boiling of the contents of the pot is necessary that those who eat shall eat cooked food. Mystifying, this, you say; and so it is at Boston, just now. The gentlemen who controlled, a year or more ago, the charging and drawing of the retorts in the works of the Boston Gas Light Company, are, to use the slang of the day 'not in it.' And why is it that they are on the exterior? In primer reply, let me say, 'Because those who succeeded the Greenough estate'—and its memory will be ever as pleasing as are the odors from the green bay tree—'have installed a pruning machine, in the shape of an adjunct that puts the stoker in fear of correction and under measurable control.' This outburst of incoherence is prompted through my having knowledge of the passage, at Lusitania Hall, Hanover street, Boston, some days ago, of a series of resolutions adopted by Local Assembly 7,597, Knights of Labor, whose membership is largely composed of "gas house" employees of the old Boston or Bay State Gas Company. The "Knights'

decreed that "The continued introduction of water gas is an imposition upon the public; it gives the people an article far below coal gas in illuminating power, and throws a large number of men out of work, without giving the consumer a corresponding benefit in the reduction of his gas bill." All of which is submitted in support of the proposition that those who own a goose capable of producing argentiferous eggs should be content with a crop of feathers rather than that the bird should be carved up for the gustatory pleasures of the table—a goose, like other fowls, dies but once; and when dead is not of any value unless eaten within a reasonable time from the day that its head was cut off.—OBSERVER."

THE Directors of the Atlantic City (N. J.) Electric Light Company have determined that on and after Feb. 1, next, a day current will be supplied from the works.

IN the case of the authorities of Minneapolis against the local Brush Electric Light Company, a suit on a bond to recover $2,100 collected from the city by the Gas Company for lighting Bridge Square by gas some months after the contract with the Electric Light Company was entered into, Judge Young decides for the defendant, on the ground that the city might have put out the lights promptly, and so saved the expense for gas. In other words, the Company should not be held liable for the neglect of the authorities.

JUDGE SIMONTON, in a decision rendered at Harrisburg, Pa., on the 18th inst., says that as electric light companies are not manufacturing corporations, they are therefore liable to a tax on their capital stock.

MR. DEAN ADAMS, Secretary of the Pulaski Gas Light Company, of Little Rock, Ark., has notified the shareholders that the annual meeting of the Company will be held on the 12th prox.

THE Directors of the Davenport (Ia.) Gas Light Company have elected Mr. N. G. Pendleton, of Cincinnati, Ohio, to be Secretary and Treasurer. Mr. T. G. Gaylord, of Louisville, Ky., is to act as General Manager.

MESSRS. JOHN WARD and J. S. Chumley are said to be making an investigation at Hill City, Tenn., with a view to determining the feasibility of establishing a gas works there.

AN important reduction in the gas rate at Batavia, N. Y., has been ordered.

SUPT. AMBROSE H. RAUCH, of the Bethlehem (Pa.) Gas Company, is overseeing the construction of a water gas plant for the Company, which is being put in under a contract awarded to the United Gas Improvement Company.

Fast and Fugitive Coal Tar Colors.

By PROF. J. J. HIMMEL.

The work of Abney and Russell a few years ago established the fact that water-color artists have a good gamut of permanent colors available for their art, and that there is no necessity for them to employ colors of a fugitive nature. Although the work of the dyer is by no *means* to be compared with that of the painter in artistic merit, nevertheless in art tapestry it seems desirable, at any rate, that dyestuffs should be employed which are of a permanent character. Such considerations also apply in a lesser degree to all manner of textile fabrics in common daily use. In discussing this matter it is important to bear in mind that the terms "fast" and "fugitive," as applied to colors, mean different things to different persons. The author considers a "fast" color to be one which will not fade when exposed to light and atmospheric influences, whilst others use the term for colors not impoverished by washing with soap and water, and for those that withstand the action of milling, scouring and stoving, in the manufacture. As a matter of fact, no dyed color is absolutely fast, even towards a single influence, and it certainly cannot pass unscathed through all the operations which it may be necessary to impose upon individual colors applied to this or that material. Dyestuffs have to be chosen with regard to the duty they have to perform.

The problem, then, of producing fast colors is rather one for the color manufacturer than for the textile colorist, and, indeed, in the so-called alizarin colors we have already received at his hands a goodly range of fast-coloring matters, which makes it almost possible for the dyer to dispense, if need be, with nearly every one of the dyewoods. In many cases questions of price render this entire abolition of old for new coloring matters impossible during this age of competition; neither would it be in all cases desirable. The textile colorist, however, can also do excellent service in the cause of fast colors by thoroughly examining the capabilities of all the coloring matters and mordants now at his command, and particularly by exercising a wise discretion in their combination and their use. Unfortunately, here again trade competition steps in and mars the excellent results which might otherwise be obtained, and the general public suffers because this bane of modern commerce has too often compelled the dyer to employ coloring matters more or less unfitted for the material and its ultimate use.

When we study the action of light on coal tar colors, we find that, whereas the members of some groups are for the most part fugitive, the members of other groups are nearly all fast, and it becomes at once evident that the chemical constitution of a coloring matter exercises a profound influence upon its behavior towards light. Those coloring matters in which the atomic arrangement is similar to that in magenta—*e.g.*, malachite green, methyl violet, victoria blue, etc.—are all similarly fugitive to light. On the other hand, those coloring matters which are closely allied to alizarin possess generally the quality of fastness to light. Members of the eosin group are, for the most part, extremely fugitive; those of the indolin group are comparatively fast. In the azo group some are fast and others fugitive. It is scarcely necessary to say that the fastness to light of a color is independent of its commercial value, this being mainly determined by the price of the raw material from which it is manufactured. Neither must we suppose that facility of application of a coloring matter necessarily interferes with its fastness to light, for, as a matter of fact, some of the fastest coal tar colors on wool—*e.g.*, tartrazin—are applied in the simplest possible manner. On the other hand, the intensity of depth of a color has more influence on its fastness. Dark full shades invariably appear faster than pale ones from the same coloring matter, simply because of the larger body of pigment present, and the fading is consequently not so perceptible. A pale shade of even a very fast color will fade with comparative rapidity, and the fugitive character of many of the coal tar colors is rendered more marked because there is often such an infinitesimal amount of coloring matter on the dyed fiber. Of coal tar colors we have at the present time about 300 distinct kinds, of which about 30 give extremely fast colors, and an equal number or more give moderately fast colors. On the other hand, out of about the 30 natural dyestuffs usually employed, we may count ten as giving fast colors. We have therefore a total of about three times as many fast coal tar colors as we have of fast natural dyestuffs. A process of selecting the fittest has gone on in the past with respect to the dyewoods, and such is the sifting process now at work among the coal tar colors. The prejudice against the new colors is chiefly due to manufacturers selecting colors mainly on an inspection of their tint, irrespective of any experiments with regard to their fastness and suitability for any particular class of work. By judicious selection and careful experiment the good will be gradually distinguished, and both the manufacturer and public will recognize that there is both beauty and permanence in the coal tar colors of to-day.

The Lynn (Mass.) Gas Company and the Underwriters.

The *Standard* says that an interesting question of liability arises in connection with the fire and explosion which occured in the works of the Lynn Gas and Electric Light Company, Lynn, Mass., recently. The fire started in the wire tower, and caused the short-circuiting of several wires. This, the gas company claims, so accelerated the speed of the Corliss engines, running the dynamos, as to cause an explosion of the great fly-wheel and several smaller wheels. The gas company claims that the insurance companies are liable for the loss, as the explosion was the result of fire. The insurance companies deny liability, holding that while the explosion may have occurred as a sequence to the fire, the simple short circuiting of wires was not sufficient to demoralize a Corliss engine unless there was a defect in the mechanism, the result of carelessness or inattention in running the same. It has been demonstrated since the fire that the engineer was not at his post when the fire occurred, and that his first efforts when hearing of the fire were not directed toward the care of his engine. Had he done what he should have done, the accident would not have occurred.

Although the case has as yet assumed nothing more than a difference of opinion between the assured and the companies as to liability, the companies will resist if the case is carried to the courts. Messrs. Hess, Baker, Gray and Grover have the adjustment in charge for the companies. The loss from actual fire will be about $300; the loss from the explosion may exceed $10,000. Pending decisions, an appraisal of the fire loss and of the explosion loss will be made separately, so that the assured may at once proceed to repairs.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,

16 Wall St., New York City.

December 29.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	92	93
Central	500,000	50	90	85
" Scrip	220,000	—	95	100
Equitable	4,000,000	100	116	120
" Bonds	1,000,000	—	113	115
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	110	115
Mutual	3,500,000	100	117	120
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	—	—
" Bonds	150,000	—	—	100
Standard Gas Co —				
Common Stock	5,000,000	100	—	48
Preferred	5,000,000	100	—	90
Yonkers		50	112	—
Richmond Co., S. I.	346,000	50	—	—
" Bonds	20,000	—	—	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	117	120
Citizens	1,200,000	20	85	90
" S. F. Bonds	320,000	1000	100	103
Fulton Municipal	3,000,000	100	130	132
" Bonds	300,000		100	105
Peoples	1,000,000	10	85	90
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	100	—
Metropolitan	1,000,000	100	100	107
Nassau	1,000,000	25	130	—
" Ctfs	700,000	1000	95	100
Williamsburgh	1,000,000	50	128	130
" Bonds	1,000,000	—	108	112
Out of Town Gas Companies.				
Boston United Gas Co. —				
1st Series S.F. Trust	7,000,000	1000	—	87
2d " " "	3,000,000	1000	—	75
Bay State Gas Co. —				
Stock	5,000,000	50	52	55
Income Bonds	2,000,000	1000	95½	—
Buffalo Mutual, N. Y.	750,000	100	90	95
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
" " Bonds	45,000	—	—	—
Chicago Gas Company	25,000,000	100	33¾	—
Chicago Gas Light & Coke Co. —				
G't'd Gold Bonds	7,650,000	100	84¾	85½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	98
People's Gas and Coke Co., Chicago —				
1st Mortgage	2,100,000	1000	—	100
2d "	2,500,000	1000	94	98½
Consumers Gas Light Co., Jersey City	2,000,000	100	—	30
Bonds	600,000	1000	80	—
Cincinnati G. & C. Co.	6,500,000	100	204	205
Consumers Toronto	1,000,000	50	190	200
Central, S. F., Cal.			80	90
Capital, Sacramento, Cal			58	
Consolidated, Balt.	11,000,000	100	46	46⅞
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	110
Bonds	250,000		—	—
East River Gas Co., Long Island City	1,000,000	100	100	105
Bonds	500,000	100	100	102
Hartford, Conn.	750,000	25	102	108
Jersey City	750,000	20	165	170
Louisville, Ky.	2,570,000	50	125	130
Little Falls, N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103

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POSITION DESIRED.

A Superintendent of Gas Works, in charge of present works for 18 years, with excellent recommendations from present Company, wishes to change for a larger establishment, where his skill in manufacturing gas would find a larger field. Has a thoroughly practical knowledge of gas fixtures, street mains, water and gas fittings. At present works, output 45,000 feet per night. Please address WILLIAM H. ROBERTS,

812-1 188 W. 101st Street N. Y. City.

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KNOXVILLE GAS LIGHT CO.,

812-8t Knoxville, Tenn.

Dissolution of Co-Partnership

The firm of CONNELLY & CO. is this day dissolved by mutual consent, J. S., T. E., and J. W. Connelly retiring, and S. F. Hayward continuing the business, incorporating under the name and style of the "CONNELLY IRON SPONGE AND GOVERNOR CO.," assuming all liabilities of the late firm, and authorized to collect all outstanding accounts.

J. S. CONNELLY,
T. E. CONNELLY,
J. W. CONNELLY,
S. F. HAYWARD,

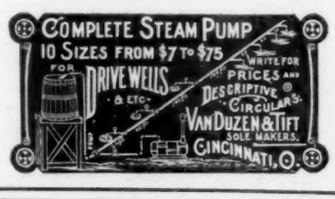
The retiring members take this opportunity to thank their many patrons for the liberal patronage they have enjoyed, and would respectfully solicit a continuance of the same for the new Company, bespeaking for them an earnest desire to please in all their dealings.

J. S. CONNELLY,
T. E. CONNELLY,
J. W. CONNELLY.

We should be pleased to receive a continuance of the favors extended to the old firm, and hope, by a vigorous, energetic pushing of the business and fair dealing, to deserve it. Thanking you in advance,

CONNELLY IRON SPONGE AND GOVERNOR CO.

December 1, 1890. 812-6



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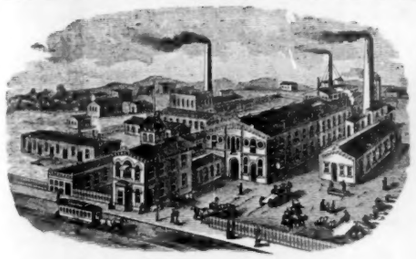

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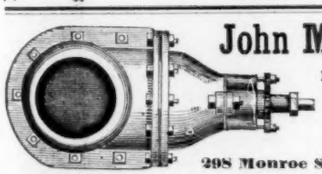

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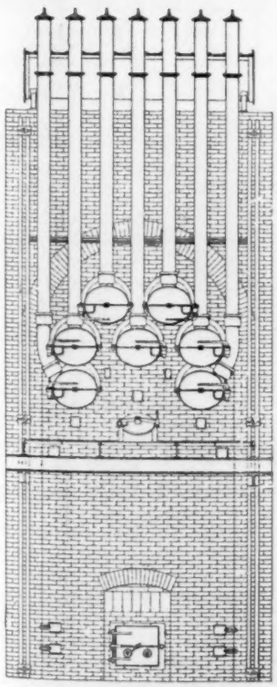

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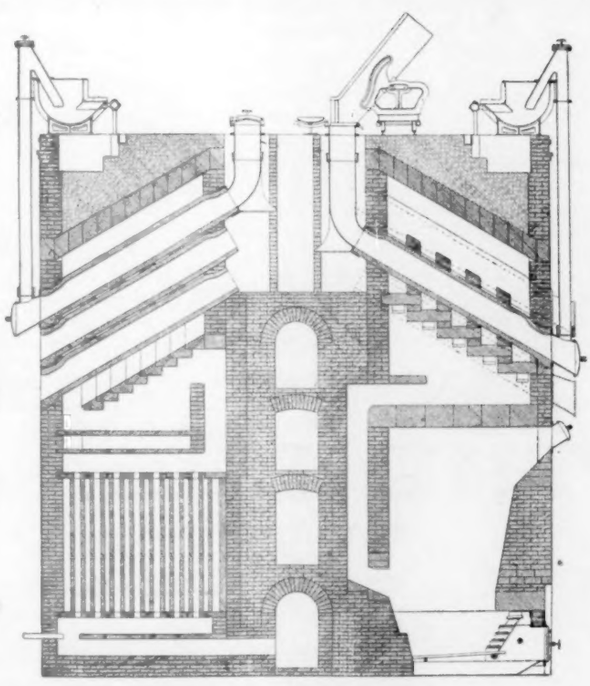

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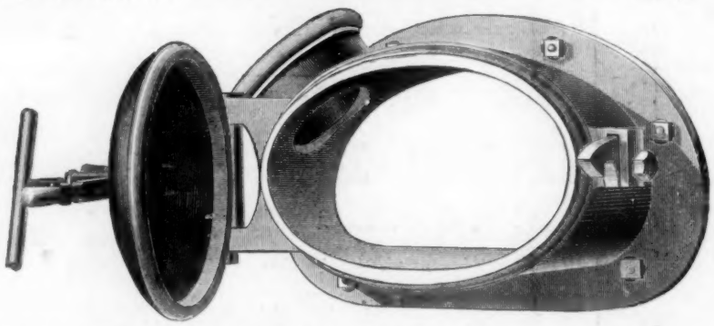

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This Mouthpiece and Lid was introduced to the public in 1884, and since then large numbers have been manufactured and sold.

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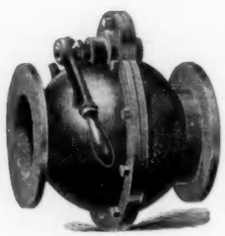

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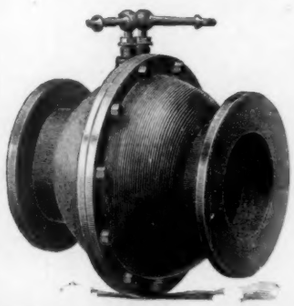

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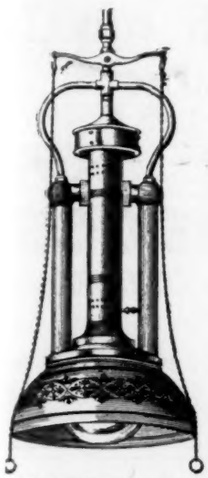
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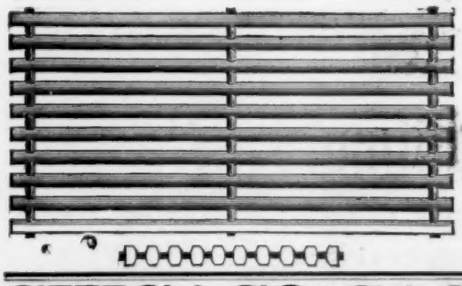

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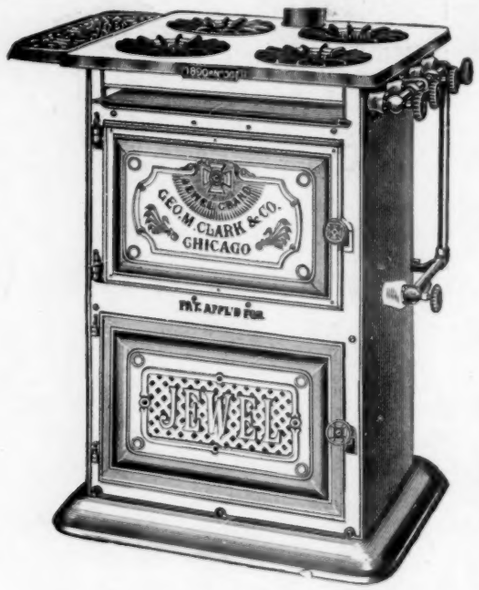

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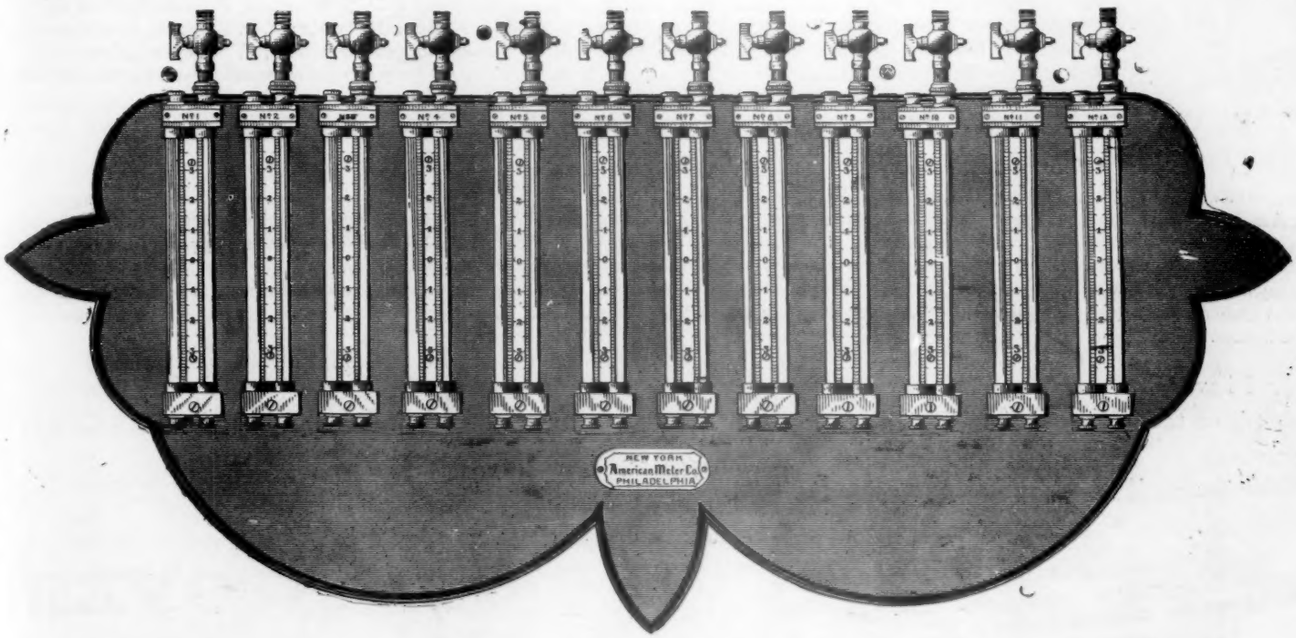

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A very general demand exists, in both large and small Gas Works, for an apparatus that will be absolutely efficient in the removal of the tar which passes the hydraulic main and condenser. Many attempts have been made to accomplish this, but, I believe, without success, until the introduction, five years ago, in England, of the C. & W Walker Patent Tar and Carbonic Acid Extractor. During these years this apparatus has been adopted by many of the most prominent Engineers, not only in England, but also on the Continent of Europe and in other parts of the world. It is only necessary to give here a partial list in order to convince any intelligent American Gas Engineer that this machine must have succeeded fully in accomplishing the desired results.

The following Engineers have personally given permission to refer to them:

G. C. Trewby, Esq., Engineer-in-Chief of the Gas Light and Coke Co., London. The manufacturing plant at Beckton is built in complete sections of 3,000,000 cubic feet capacity each. A Walker Tar Extractor has been fitted to each one of these sections. This was done after a long and thorough trial on one of its sections. The Tar Extractor has been supplied to other works of the Gas Light and Coke Co., including those of which John Methven, Engineer of the Gas Light and Coke Co. at the Nine Elms Station, is in charge. Also to G. E. Stevenson, Peterborough Gas Works; B. Green, Mitcham and Wimbledon Gas Works; W. H. Smith, Bedford Gas Works; F. Linging, Norwich Gas Works; J. T. Browning, Colchester Gas Works; S. B. Darwin, Portsmouth Gas Works; J. McCrae, Dundee Gas Works; W. J. Wells, Stamford Gas Works; J. M. Darwin, Longton Gas Works; J. Paterson, Warrington Gas Works; and J. Coulter, of the Dundalk Gas Works. All of the foregoing gas works are located in Great Britain.

Mr. Charles A. Gerdenier, Superintendent of the Bridgeport (Conn.) Gas Light Company, writes as follows, under date of Dec. 3, 1887:

"The C. & W. Walker Tar and Carbonic Acid Extractor has been in operation at these works for the past six weeks, and is an unqualified success. It removes every particle of Tar from the gas in once passing through the apparatus, and a large percentage of the Carbonic Acid. I also feel quite sure that it prevents the formation and deposit of Naphthaline, because since I started the Washer I have had no stoppages from this cause. These works have been seriously troubled with Tar for many years, and I have used several kinds of apparatus and every expedient which has come to my attention for dealing with the difficulty, but without success. The Walker apparatus occupies comparatively small space, is less expensive than other systems, and requires but little attention. I carry 2½-inch seal, and have an automatic tar delivery valve. This Tar Extractor is indispensable to gas makers."

I have taken the Agency for the United States for this apparatus, and am now prepared to make contracts to erect it on the premises of any Gas Company. It would be manufactured in the following sizes:

No. 1,	50,000	to	100,000	cu. ft.	per	24 hrs.,	3	ft.	square,	5 ft. deep.
No. 2,	"	"	125,000	"	"	"	4	"	"	" "
No. 3,	"	"	250,000	"	"	"	5	"	"	" "
No. 4,	"	"	500,000	"	"	"	6	"	"	" "
No. 5,	"	"	750,000	"	"	"	7	"	"	"
No. 6,	"	"	1,000,000	"	"	"	8	"	"	"
No. 7,	"	"	1,250,000	"	"	"	9	"	"	" "
No. 8,	"	"	1,500,000	"	"	"	10	"	"	" "
No. 9,	"	"	2,000,000	"	"	"	12	"	"	" "
No. 10,	"	"	3,000,000	"	"	"	15	"	"	" "

This Tar Extractor will perform its work with about one-fourth the usual back-pressure heretofore required. It is simple in construction, and can be supplied at a very reasonable price—less than any other ever before introduced. Satisfactory results will be guaranteed in every instance.

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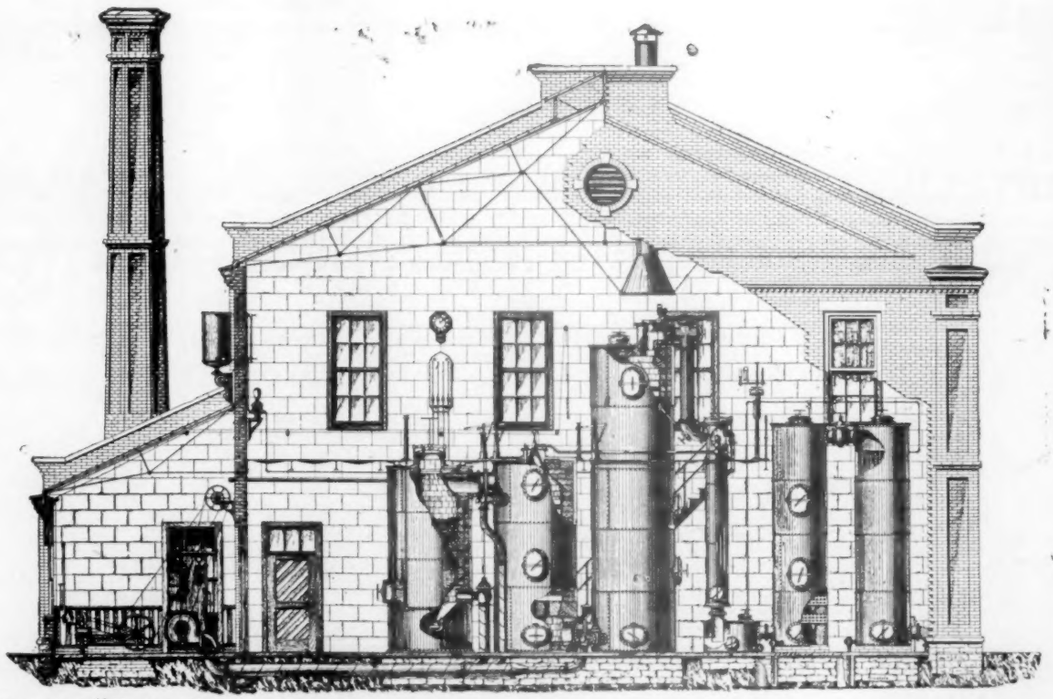

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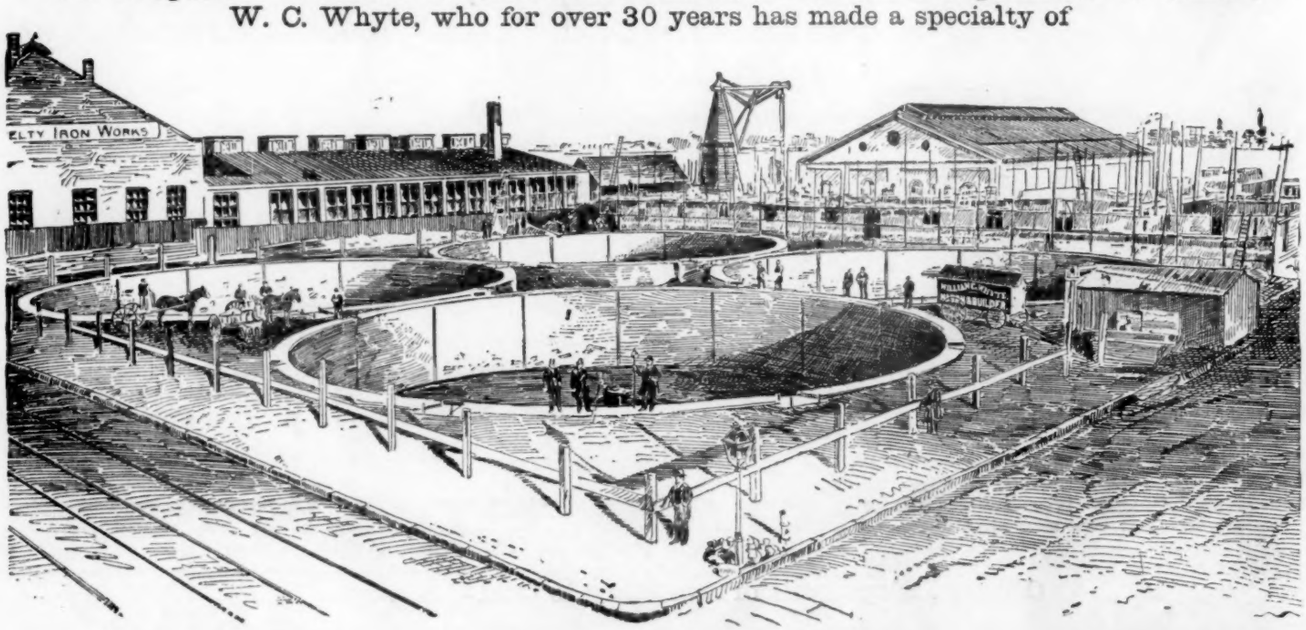

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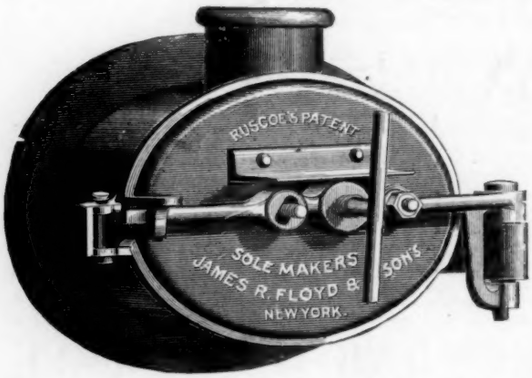

This Lid and Fastener is specially designed for taking up the wear and tear caused by refacing the Mouthpiece and Lid, hitherto in a large measure overlooked; and, in addition, from the special way in which the Lid is attached to the Cross-bar, the Lid has free action, and thus secures a more uniform scrape over the whole surface when being forced home by the Screw, the closing pressure being much more equally distributed than in any other form of fastening.

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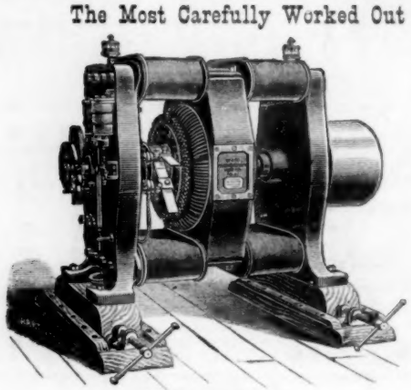

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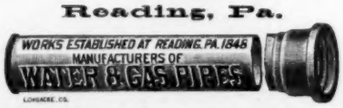

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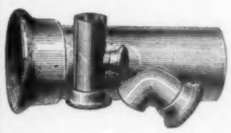

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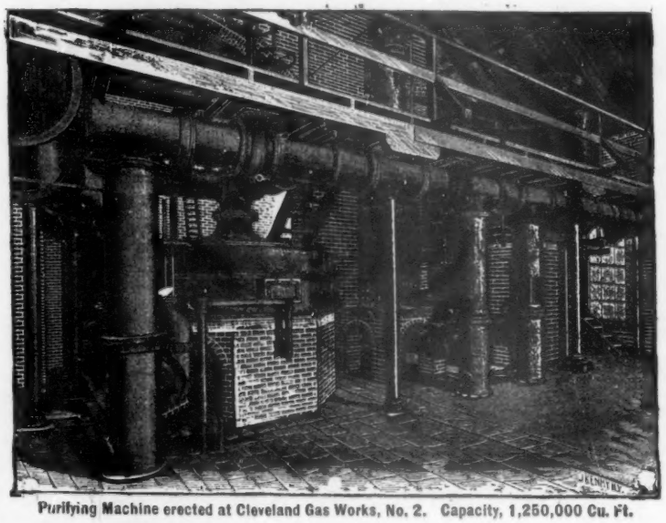

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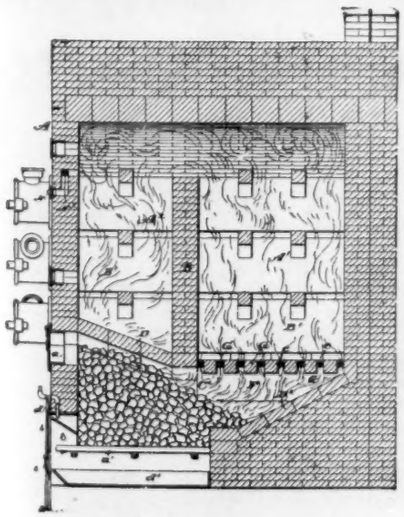

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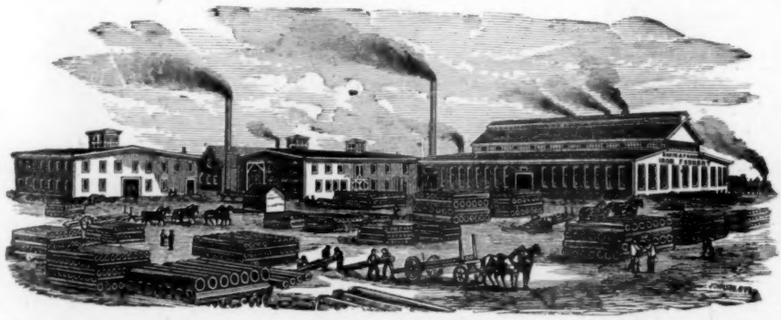

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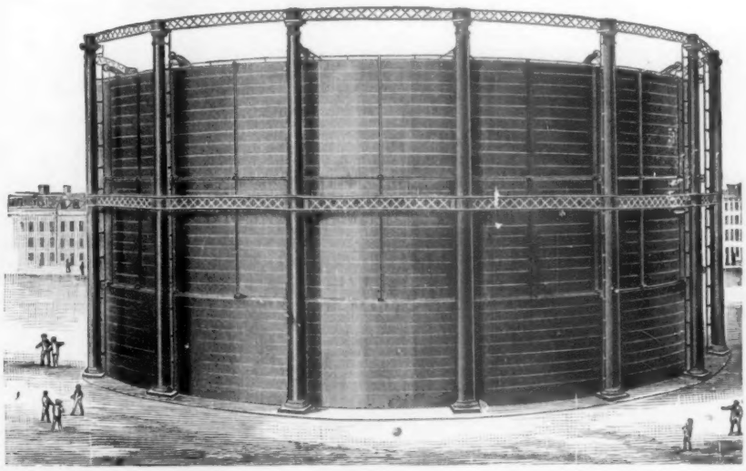

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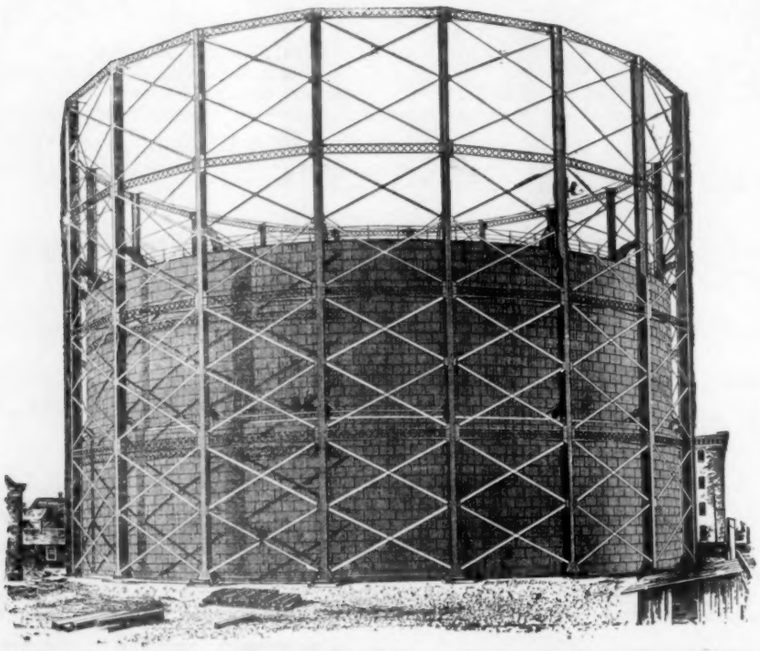

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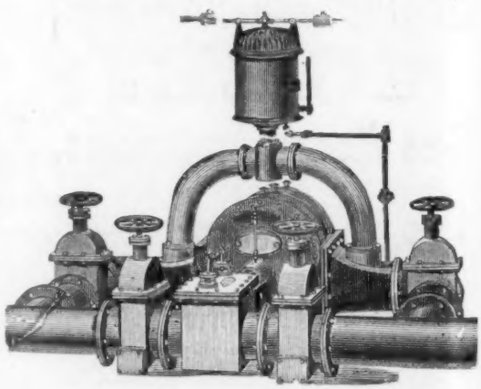

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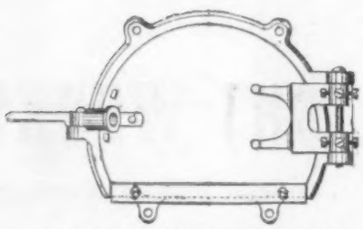

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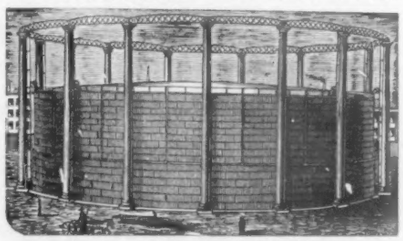
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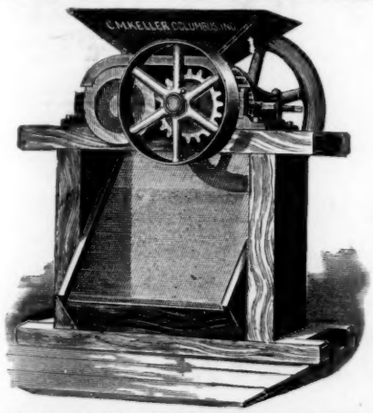

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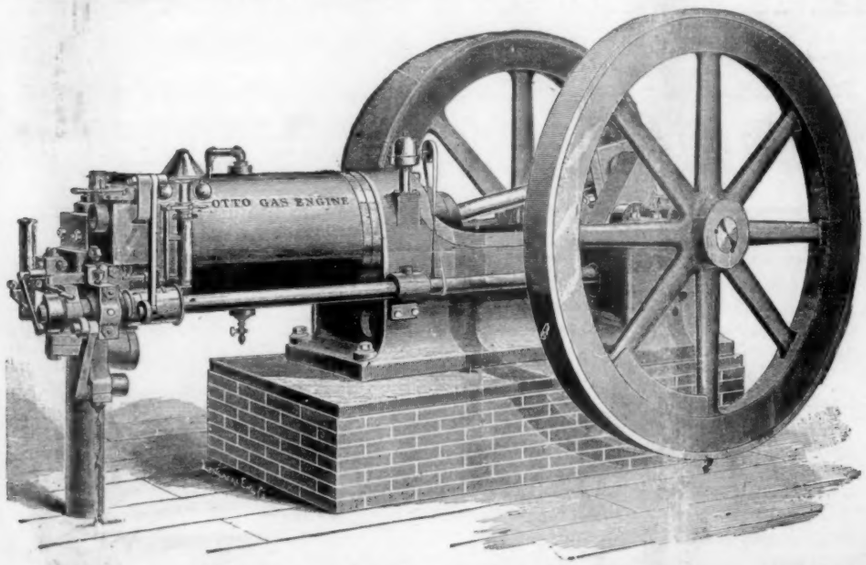

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